

SYNOPSIS

STATISTICAL METHODS FOR ACTUARIES

BY PATRICK CARROLL

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STATISTICAL METHODS are central to actuarial investigation. This emphasis has increased with the move away from a primary concern with life and pension matters, where the focus is on deterministic models. The increasing pressure on available space in the professional examination syllabus means that it is important that an appropriate selection is made from the available statistical methodology. Unfortunately actuarial problems are characterized by skewed distributions, correlated errors, situations which call for multiplicative rather than additive models, and a host of other 'non-standard' features. The paper comprises a wide ranging review of modern statistical methodology and an appraisal of the value of each method for actuarial investigations.

An extension of the basic techniques already central to actuarial training is advocated. In particular the summary and display of data including multivariate data, the use of data transformations, distribution-free (non-parametric) inference, the use of a wider range of distributions, in particular the 'stable-law' family, and a greater appreciation of the secondary use of data from government and market research sources. All this is possible with only a limited extension of the calculus and algebra requirements for students and by exploiting modern computing resources.

The paper then deals in detail with the major subject areas which should be considered part of professional or post-qualifying training.

Multivariate methods have 'come alive' by virtue of computing power. No other body concerned with large data bases has ignored them. The uses of multiple regression, principal components, factor analysis, cluster analysis, multi-dimensional scaling, correspondence analysis, canonical variate analysis and discriminant function analysis are outlined. Examples of the use of each technique are described.

Survival analysis has developed with increasing rapidity since Cox's 1972 paper on Regression Models and Life Tables. The principles of survival analysis are entirely consistent with traditional actuarial methods. The straightforward methods of estimating survival distributions for individual level data and the non-parametric testing of hypotheses are ideally suited to the examination syllabus. The full Cox model with its estimation difficulties is described in detail. An appreciation of these methods is essential for the preparation of life underwriting manuals using the recent literature in medical statistics. The whole

subject is an important component of post-graduate and/or post-qualifying training.

Traditionally smoothing formulae have only been used for graduation. An extension of such techniques leads to the modelling and forecasting of Time Series. The actuarial literature of recent years abounds with examples of the use of Box-Jenkins models, particularly for investment problems. The presence of elementary time series modelling in the statistics syllabus and its use in research in one area suggests that it is an important subject for more detailed examination coverage, and possibly fruitful as a research method in other areas, particularly general insurance.

The development of Generalized Linear Models and their estimation using the GLIM software package is described. Several examples of the use of these models in general and life insurance are given. The subject is seen as an essential part of post-examination training. However the key approaches to GLIM modelling, e.g. the use of log transformations, likelihood ratio testing, etc., could be introduced into the current examination without major disruption.

Bayesian Inference has been neglected by the majority of actuaries. The development and use of Credibility or Experience Rating in North America and Continental Europe has shown that Empirical Bayes Methods can provide a productive approach to problems in Risk Theory. Unfortunately the mathematical sophistication required for a full treatment of the topic makes it unsuitable as a major component of examinations and probably only accessible to a limited number of actuaries in a post-qualifying course.

The paper concludes with an extensive bibliographic note, which provides a guide to the more recent texts in all subject areas. Some papers which give examples of the use of the new techniques in actuarial research are also cited.

PARTNERSHIP PENSION ARRANGEMENTS

BY GEOFFREY BERNSTEIN

(Synopsis of a paper presented to the Society on 21 January 1986)

THIS paper outlines some of the recent developments in the field of planning partnership pensions. The word 'partner' refers to one of a group of people working together in an unincorporated body. They are taxed as 'self-employed'. The legislation governing their pension provision is quite different from that of employees taxed under Schedule E. The paper focuses particularly on self-invested funds available through insurance companies or through a 'captive or private' friendly society.

Pension planning is an integral part of overall partnership planning which includes:

- (i) Getting clients' work done,
- (ii) Raising capital,
- (iii) Reducing the immediate tax bill,
- (iv) Securing the partnership succession.

In solving the partners' pension problem, the consultant can contribute to the solution of other financial problems, including (ii), (iii) and possibly (iv) above. In essence, financial planning for a partnership is an extension of personal financial planning. The appraisal of the current position and the setting of objectives for the future are discussed. The advantages and disadvantages of the various options available to reconcile these two are described. The special role of the actuary in assessing the value of the current and proposed benefits on a realistic and consistent basis is discussed.

Retirement Annuity Contracts approved under § 226 of the Taxes Act form the basis of insured pension schemes. The paper describes three aspects of these policies which may be of particular interest to actuaries:

- (i) the analysis of policy charges,
- (ii) the appraisal of investment performance,
- (iii) loanbacks.

The insurance companies' expense loading comes in the form of charges deducted from premiums and the funds under management. These charges, averaging 20 to 25% of each premium, are significant in evaluating the returns from policies. Choosing a company with only average investment performance, but with a lower level of charges than other companies, has the potential for dramatically improving the overall return. Charges can be reduced by (i) using a series of single premium policies rather than a regular premium one, (ii) using the partnership's purchasing power to obtain 'quantity discounts'.

Consistently good long-term investment performance will dominate any charging structure, but such returns are difficult to achieve over a period of 20 or more years and the policyholder faces the difficulty of determining which company will do well in the future.

Choosing an investment manager or life office to look after your money may be more difficult than choosing the investments. The choice is bewildering and any simple rule of thumb methods for choosing a suitable investment medium would certainly be very useful. One of the more frequently quoted observations is that unit linked funds tend to do better in the early years, soon after they are set up, than after they have been established for some time. Calculations in the paper indicate that this may, indeed, be true for retirement annuity funds, in particular Managed and U.K. Equity and Fixed Interest Funds, although the effect is quite small. There are many behavioural models postulated to explain this phenomenon, but it is not possible to gather data which support a single explanation. To base an investment strategy on an unexplained and perhaps irreproducible effect cannot be regarded as a sound policy.

Nearly all retirement annuity policies are packaged to include some form of loanback arrangement. Legislation and revenue practice prevents the use of the annuity policy as security for any loan and the granting of loans at non-commercial rates. Loans without restriction as to use will usually require security, whilst unsecured loans will have restricted use and usually have a maximum term of 25 years. In either case such loans do not easily fulfil the capital needs of the partnership or of individual partners. The paper discusses the forms of possible loans and their drawbacks.

The capital requirements of a partnership can often be more easily met by self-invested and/or administered schemes. Provided that suitable safeguards can be devised, many partnerships must wonder why their retirement annuity funds should not be used to capitalize their own businesses rather than being invested out of their reach. It would be quite outside the spirit and scope of the legislation for annuity funds to be employed directly in the practice. Nevertheless, these maybe perfectly sound investments which might also benefit the partners' business indirectly. In particular, for the annuity fund to purchase property which can be leased to the partnership on commercial terms may be an excellent, secure investment. The paper discusses in detail the advantages of such an arrangement.

An insurance company self-invested scheme can be a half-way house between an insured and a self-administered scheme. A number of companies are now prepared to set up a segregated retirement annuity fund for one or more individual policyholders, for example, the partners in one firm. In principle, the insurance company hands over the investment control of this fund to the policyholders. In practice, it is somewhat more complicated than that. The company places restrictions on the self-investment policy so that its overall investment strategy is not adversely effected by activity in the segregated fund. The form and implications of these restrictions are discussed.

An extremely intriguing and quite practical alternative proposition is for the parties to set up their own 'private' friendly society. The society can transact the partners' retirement annuity business in the usual way and with all of the usual tax privileges. The annuity contracts are, in all important respects such as limits on qualifying premiums and tax-free lump sums at retirement, identical to those issued by insurance companies. The friendly society's investments are not subject to tax, provided the necessary approvals can be obtained.

This arrangement enables the partners to have control through the society of their investments. The relationship is even more direct than investment through an insurance company's segregated fund. The society can invest in property which can be leased to the partnership. It can also provide up to 100% loanbacks on a secured basis. At the same time, the costs can be much lower than for an insurance company's segregated fund. The establishment, administration and investment policy of such a friendly society are described in detail.

Whilst the main themes of the paper are those already described, some alternative methods, worthy of consideration, are outlined.

Some partnerships have found it worthwhile to set up limited companies, owned by the partners, to conduct part of their business. For example, a firm of accountants might set up a management consultancy company. The company will then charge its clients for its work and may well employ various members of the partnership. Their remuneration from the company will be taxable under Schedule E. It will therefore be possible for the company to establish a scheme approved under the Finance Act 1970 to provide pension benefits for those partners who are employed by it. Such an arrangement allows the partners to take advantage of the less severe restrictions on contributions, and constraints on investment policy allowed to these schemes, compared to the §226 pension arrangements. Possible optimum employment arrangements, i.e. partner *v.* employee, are discussed.

The possibility of using § 226(5) of the Taxes Act to establish a trust fund is mentioned. It is noted that virtually no such funds exist at present.

It is, of course, open to the remaining partners simply to provide an annuity to their retiring colleagues out of the practice's income on a year-to-year basis. The disadvantages of such a 'pay as you go' scheme are discussed.

Successive governments have sought to encourage individuals' saving for retirement since it is clearly desirable that they should not be a burden on the State in their old age. In the meantime their savings will form a useful capital base for the country. The Government's chosen method has been to provide tax incentives for savings schemes which satisfy certain restrictions laid down in the various Acts. These are aimed at limiting the dates at which savers can withdraw their savings to around their retirement age and ensuring that the bulk of the savings have to be withdrawn as life annuities. In addition, the savings must be managed by an insurance company or friendly society. Possible changes that would make this legislation less restrictive yet still ensure that the stated objectives are achieved are discussed.

The paper concludes with some practical guidelines crystallized from the earlier discussion.

PROMISES, PROMISES:

The Myth and Reality of Life Office Quotations

BY M. IQBAL AND E. SHORT

(A synopsis of a paper presented to the Society on 18 February 1986)

THE Government's success in reducing inflation to around 5% and the long term rate of interest to around 11% and the likelihood that the days of high interest rates are unlikely to return in the near future has put the current rates of bonus under severe strain. Inevitably they must fall at some stage. This poses an urgent

problem because of the industrywide practice of providing quotations assuming that the current rates of reversionary and terminal bonuses will be maintained.

Section 73 of the Insurance Companies Act 1982 makes it an offence for a company to make misleading statements when inducing people to enter into contracts of insurance. However, this piece of legislation has not been very effective. A quotation, or an illustration or a projection fulfills two specific functions:

- (i) It gives an indication of the likely emerging benefits if certain stated assumptions are borne out,
- (ii) it helps in the choice between one or two insurance products or between an insurance product and the product of another savings institution.

We believe that the first function should be all important. In practice too much attention is paid to the latter with the quotation operating as an instant discriminator between companies.

The present practice in respect of with profits business is fallacious for several reasons:

- (i) Bonuses granted in days of high inflation are being projected into a future of low inflation,
- (ii) Current terminal bonuses are often added to current reversionary bonuses,
- (iii) No attempt is made to relate monetary figures to their real values allowing for inflation—particularly acute in the case of pension products.

The present practice on unit-linked business is much more acceptable, particularly that of giving two illustrative values. Nevertheless there are inconsistencies in their treatment of expense charges. There are also instances of offices using unacceptably high growth rates.

If quotations are so potentially misleading is there an alternative? There is a growing body of opinion that more attention should be given to past performance. However that can be misleading too. For example, a company

- (i) may have changed its investment policy significantly,
- (ii) may have consciously or otherwise overdistributed surplus in the past, leading to better past performance but a weaker financial base for the future,
- (iii) may have expanded much faster than others and thereby accepted more business on unsupportable terms,
- (iv) may have done very little with profits business until the past decade or so making it very inexpensive to generate good past performance with very high terminal bonuses.

The Financial Services legislation makes it imperative that a sensible basis be evolved (a) to make sure that offices comply with the requirement not to make misleading advertisements and (b) to enable intermediaries to offer best advice to their clients.

There is no unique solution. We would recommend the following:

- (i) A system of risk classification should be devised and all investment products should be given a risk rating,
- (ii) Illustrations should be shown on two alternative investment assumptions to convey the inherent uncertainty of final outcome,
- (iii) The two assumptions should be very wide, 5% and 10% for life products and $7\frac{1}{2}\%$ and 15% for pension products are recommended under current conditions.
- (iv) A corresponding rate of inflation (10% price, 12% earnings) must be shown,
- (v) If past performance is being used, it is best to use externally published league tables. If it is to be an integral part of the illustration basis this measure must relate to a comparable product. The return must be expressed as an overall yield on the gross premiums invested and the corresponding average annual rate of price inflation must be shown,
- (vi) Specific guidance should be given to appointed actuaries not to overdistribute simply to inflate league table position and possibly to add a note along the following lines whenever past performance is used in the sales process:
‘Although past performance is no guide to the future, the Company has been advised by its Actuary that given similar investment conditions a similar result can be achieved for the current generation of new policyholders’—assuming that it can honestly say so,
- (vii) Avoid spurious accuracy by sensibly rounding figures.

***NORTH AMERICAN CASUALTY BUSINESS
WRITTEN IN THE LONDON MARKET***

BY JOHN P. RYAN

(Synopsis of a paper presented to the Society on 18 March 1986)

THIS paper is an introduction to the actuarial aspects of U.S.A. Casualty business written in the London Market. It provides an indication of the type of problems encountered and how the business differs from that in other fields perhaps more familiar to non-life actuaries in the U.K. Whilst premium rating and claims reserving are central to the discussion, particular techniques are not described in detail. Various aspects of the legal, fiscal and institutional facets of the market are described with the aim of giving the background knowledge essential for effective data analysis for rating and reserving.

The key difficulties are the especially long tails of the business and the relative short experiences of companies and syndicates writing the business. For many

covers the length of the tail can be at least 25 years and a large number of underwriters only began writing business in the 1970's and 1980's.

A company's own data, when broken down into homogeneous risk groups, is rarely large enough for full credibility. The actuary is compelled to use additional data from industry sources. The paper describes the availability and characteristics of data published by the Reinsurance Association of America (RAA), Best's, National Council for Compensation Insurance (NCCI) and Insurance Services Office (ISO). It is also noted that the information filed by individual companies when applying for a rate revision is publicly available in each state. Many of these applications contain supporting data collected on a countrywide basis. The role of judgment in choosing the appropriate U.S.A. data for an investigation of London market business is emphasized. Examples of the data available and indications of the consequences of inappropriate choices are given.

In addition it is important to make allowances for the impact of changes in the mix and handling of London market business, when compared to the overall U.S.A. business. Particularly important factors are faster reporting of claims, more conservative case estimation, the impact of reinsurance programmes, policy limits, differences in layer and attachment points, introduction of a limited number of reinstatements. The preference is for scanty and homogeneous data rather than larger but heterogeneous groupings. The estimation of trending factors presents less of a problem for the market than is popularly believed.

The problems of reserving are discussed. The Bornhuetter-Ferguson method of claims reserving is advocated as a 'standard' method. The most appropriate distribution for rating is the log normal with suitable adjustments for nuisance claims and policy limits. Straight-forward simulation exercises are usually sufficient to check this distributional assumption and the effect of high claim severity, the long time to settlement and the high trend of claims costs, together with changing limits for deductible levels and attachment points on claims experienced.

The later sections describe the legal and institutional factors which impact upon the reported experience and which are important for the judgmental aspects of reserving and rating.

The methods of placing business are outlined, The roles of U.S.A. brokers, agents and insurers and their relationships with the 'actors' in the London market are described. It is important to understand the terms under which covers are issued, but the variety of contracts offered and the lack of detail available to the insurer make this difficult. Automobile cover offered in the London market is mainly bodily injury liability. The cover and rating structure is very different to that offered in Europe, e.g. the absence of no claims discounts, cover often on a no fault basis. A good summary on a State by State basis is published by the American Insurance Association. Other personal insurances are only a minor feature of the London market. The coverages offered under Commercial General Liability contracts are outlined. The other major component of the London market is Professional Indemnity Liability cover. The cover offered to different

groups, e.g. doctors and physicians, architects, bankers, are described. The nature of umbrella covers which provide liability cover in excess of all other such covers held by the insured are described. These covers are an important part of the London market.

Regulation of insurance is on a State by State basis with large variation in the regulations and their implementation between States. These regulations can affect all aspects of the business written; rating, reserving, solvency. Restrictions on the placement of primary business can have a big influence on the mix of business offered in the London market.

A vital distinction in the cover offered for professional liability business is between that written on an occurrence basis and that written on a claims made basis. From the insured's point of view an occurrence basis—all eligible claims arising from incidents during the period of cover are met—is to be preferred. However from an underwriting viewpoint, a claims-made basis—only eligible claims notified during the period of cover and the following short reporting period are met—presents fewer rating and reserving problems. It is essential that the exact basis of the business is known before attempting any actuarial investigations. The recent tendency in the London market has been only to accept business on a claims-made basis. Such a situation is influenced by the state of the market and may not persist when market conditions change. This position spawns the need for cover for the 'excess claims' from policies written on a claims made basis for professionals who have ceased to practice because of retirement or for other reasons. The underwriting of such business is perhaps more difficult than the underwriting of business on an occurrence basis.

An understanding of the legal background to the process of claims settlement in the U.S.A. is essential. Whilst as with other territories the vast majority of claims are settled out of court, it is court settlements which dictate the level of claims settlements. Many features of the U.S.A. system lead to higher claims settlements and increased expenses of settlement compared to other territories. The use of juries to award damages, the contingent fee system of engaging lawyers, the use of class actions where there are many similar claims against a single individual or corporation, the concept of joint and several liability in an action for damages and the possibility of the award of punitive damages are each discussed. The influence of no fault legislation on the level of damages for workers compensation is discussed.

The nature of case estimates for outstanding claims and IBNR reserves is different in the U.S.A., in part because of the much longer involvement of actuaries in non-life business. The high level of claims handling and settlement expenses means that it is vital that indemnity payments and expenses are considered separately in nearly all circumstances. The complex nature of these reserving problems is illustrated by a detailed discussion of industrial claims. The alternative bases for determining reserves are described and simple models to estimate IBNR reserves are outlined.