

## XXIV ASTIN COLLOQUIUM

*Cambridge, United Kingdom, 25-29 July 1993*

The XXIV ASTIN Colloquium was held in St. John's College, Cambridge, with most participants staying in College and the colloquium sessions being held in the Palmerston Room of the recently constructed conference suite. The setting of the College, straddling the river Cam and looking out on to the green expanse of the backs, provided a beautiful backdrop for our discussions, formal and informal, and it seemed to be generally agreed that the lack of full hotel facilities was a small price to pay for the privilege of holding the colloquium in this unique environment.

The colloquium was attended by about 200 participants from 25 different countries and 61 accompanying persons.

The colloquium began with a reception in New Court Cloisters followed by a buffet in Hall and this set the standard of conviviality for the following four days as well as providing the first opportunity for informal discussions.

### **Scientific Programme**

The scientific programme began with the opening ceremony and a formal introduction from John McCutcheon delivered in both English and French. He referred to the international nature of the profession, the increasing range of problems with which we are presented, and the wide variety of mathematical techniques required to solve them.

### **Invited Lectures**

The first session consisted of an invited lecture given by Sir Brian Corby on the topic "Wider Horizons for Actuaries". Summaries of this lecture, and of the invited lecture by Hans Bühlmann on the topic "Claims Reserves – Theory & Practice" are appended to these notes. The full text of Hans Bühlmann's lecture was subsequently circulated to participants and copies may be obtained from the conference department of the Institute of Actuaries.

### **Session A: Rating (Pure)**

Ten papers were presented on this topic, and Stewart Coutts presented a summary of them, in which he classified them into three groups.

The first group of papers cover the analysis of portfolio segments. COUTTS, DEVITT & SHAH develop a general insurance profit testing model equivalent to that used successfully in life assurance. They take the methodology further than most other authors in that they analyse information within a portfolio using GLIM. DENGSOE & LARSEN consider rating the customer rather than the

product and conclude that the past claims experience of a customer for one line of business can be a guide to future experience not only in that line but other lines also. This has marketing as well as actuarial implications. LEMAIRE looks at the effect of introducing a high deductible as an alternative to a bonus-malus system. It is concluded that a high deductible increases the variability of claim payments but produces a fairer rating system for most policyholders. ORROS & PETTENGELL present a simple interactive underwriting model for the premium rating of personal lines insurance business where the geographic area of the insured is an important insurance risk factor. The use of maps produced from a geographical information system is a key feature of the technique, which is intended as a practical premium rating tool for underwriters.

The second group of authors look at macro rating problems. HOLM & HOYLAND use a reserving package called ICRFS to evaluate the motor third party bodily injury risk in Norway. The importance of the technique is that instability in the payment year trend (inflation) can be identified and investigated. KRIETER covers the use of the partnership clause in reinsurance treaties, considering the relationship between the cedent and the reinsurer on relatively short tail business and how profits and losses will emerge over time. He investigates how a fairer division of the profit or losses can be achieved. SLEE considers the rating methodology for a class of business where no data is available. He suggests that the process should consist of five stages: hypothesis, measure, model, what if?, predict. The model must be dynamic in that it can be changed easily and must be readily communicated to the user.

The third group of papers are concerned with credibility theory and are in the main very theoretical. DANNENBURG looks at the classical Bühlmann model and investigates the estimation of the credibility factor. The results are interesting in that the simulation models show that using the usual numerical procedures the credibility factor is under-estimated. KLING looks at the De Vylder model and shows that the Taylor expansion can be used iteratively to derive an approximation which under certain conditions converges to the best linear estimate. SCHNIEPER addresses the problem that in standard credibility theory the structure parameters are estimated directly from the data, giving a posterior mean which is often biased. His approach is to treat the unknown parameters as random variables and to estimate simultaneously the a posteriori mean and the structure parameters.

### **Session B: Reinsurance**

John Ryan presented a summary of the eleven papers on this topic, dividing them into four groups.

The first group covered Rating and Related Issues. BENKTANDER develops A Stop Loss Rating Formula which is simple, elegant and practical. It is applicable for rating of a limited layer effectively as the difference between unlimited layers, although this is not generally considered to be an advisable method in practice. While stop loss has a limited market it does give the largest reduction in variance for a certain amount of risk premium. However,

unlimited stop-loss is not usually a practical proposition. HURLIMANN derives a distribution-free stop-loss premium formula for diatomic risks. He shows how to guarantee a given return based on the assumption of additivity of stop-loss reinsurance premiums and using means and standard deviations. The method cannot be adapted to limited layers without more work. KAAS examines relations between stop-loss premiums and variances. In the absence of reliable data approximate methods like the translated Gamma-approximation become viable. The paper offers much practical advice and useful techniques and outlines some pitfalls. However, the variance adjustment works only for certain adjustment points. MIRANTHIS, RYAN and SALVATORI propose a “marriage” between the actuarial approach which essentially uses past loss data to derive loss distributions to predict the future and an engineering approach which uses fault or event trees in place of the decision trees in decision analysis. Emphasis was made on the use of other disciplines apart from *pure* actuarial.

The second group on Pragmatic Problem Analysis comprised one paper, by HIRASE which looks at the system for catastrophe reserves effectively used in Japan, its problems and proposals for a new scheme. The system is of a kind rarely seen in other countries. The question was raised as to how robust the system would be to major catastrophes. In answer to a question on the tax position it seems that there are some, but not complete, tax concessions.

The third group was on London Market and Other Market Issues. CRAIG-HEAD'S contribution is an interesting paper giving background information on the London market, with the intention of being practical. Devising a reinsurance programme is a classic chicken and egg situation. The position now is that there is no LMX-on-LMX market, any first tranche LMX being written for net account, and high rates of premium are being charged for outwards reinsurance. SANDERS' paper on Catastrophe Excess of Loss Reinsurance contained some interesting statistics. Current changes in the market are that there is no more spiral, reinsurers are writing to aggregate exposures, rates have risen to more accurately reflect risks, and the perception in the UK is that the major risk is flood rather than windstorm. Today's scenario is that rates are determined by 2 or 3 leaders, capacity has been severely reduced by large losses and insolvencies, and direct rates are slower to react than reinsurance rates. For reserving, Craighead curves are difficult to apply and there is no real substitute for a full exposure analysis. The HINDLEY and SMITH paper is on the very important subject of financial reinsurance. Estimation must be made of the value for money at the commencement of each year of account to ensure equitable accounting treatment under the “clean sheet” principle, and equity between names in Lloyds' syndicates should involve smoothing. The main questions arising from this subject are whether financial reinsurance is worthwhile and whether Lloyds' syndicates should be allowed to purchase such contracts. Buyers are often unaware of exactly what they are buying. A buyer of financial reinsurance should reserve for all liabilities that might arise under a contract. The FASB standards proposed in the USA are too rigid and could produce nonsensical results, e.g. contracts specifically designed to overcome the regulations. Financial reinsurance could be particularly useful when other

forms of reinsurance are unavailable, e.g. due to under-capacity in the market.

The fourth group of papers was on Mathematical Problem Analysis. The conclusion from DAHL'S paper is that *the share of a reinsurance treaty that optimises the expected utility equals the share that optimises the excess premium revenue over the zero-utility premium*. This is an important result and is a useful formula subject to its being able to be evaluated. KREMER had developed a theory based on PML's. PML may be considered to be a property concept rather than a mathematical one and hence there is a question mark over the value of the results given the elaborate development. CENTENO investigated the effect of the retention limit on the risk reserve using the probability of ruin as a criterion. The topic is believed to be worthy of extensive analysis with more generalised assumptions. The conclusion, *that the initial reserve is not in general an increasing function of the retention, having a minimum under fair assumptions*, was variously described as "curious" and "amazing".

### Session C: Rating (Reserving)

Eight papers were presented on this topic, and Philip Taylor presented an introduction and summary aimed at stimulating discussion. He classified them into two groups, according to whether they are concerned with traditional reserving models or more mathematical models.

The first group of papers re-examines traditional reserving models. SVENDSEN develops a reserving method which uses the life assurance technique of commutation columns. The reserve is calculated as a proportion of the total cost, the proportion depending only on the age of the claims. Changes in reserves may be analysed in terms of risk and interest components. AJNE looks at the conditions under which two sets of data may be combined without the results of a chain ladder calculation being distorted i.e. the chain ladder projections are additive. Necessary and sufficient conditions for this property are given, as are sufficient conditions for inequality. VERRALL considers the application of state space modelling to the chain ladder linear model in order to allow the development parameters to vary with accident year. The data is used in a recursive way so that there is an assumed relationship between the data in successive accident years. The paper by MACK, which was not circulated in advance, deals with the question of the stochastic model underlying the chain ladder. It is demonstrated that the underlying model is in fact a distribution free stochastic model rather than the loglinear approximation which has been used by several authors, and that these two models represent different philosophies of the claims process.

The second group of papers is concerned with research into new statistical methods of claims reserving. The first paper, by NORBERG, addresses the problem of drawing inferences from the data about the probabilistic laws governing claim size and claim development and using these as input to a model based on a marked Poisson process. Formulae for obtaining outstanding claims reserves from the model are derived. HESSELAGER also develops a model

based on the marked Poisson process, examining the various states such as IBNR, reported and settled. In order to compute outstanding claims reserves using this multi-state model, information on the frequency of transitions between states and the average payment per transition is required and must be derived from the data. RENSHAW gives an overview of the potential of Generalised Linear Models (GLMS) for modelling the claims process in the presence of rating factors. Specific attention is focused on the variety of modelling distributions which can be used to model the claim frequency and claim severity components. PARTRAT examines the problem of modelling claim frequency when a claim may have several segments, such as Motor accidental damage and bodily injury, and illustrative examples are given. Poisson and mixed Poisson distributions are used in the modelling process.

### **Session D: Reporting**

This Session was introduced by Colin Czapiewski. Whereas actuarial reporting is necessary and prevalent in life and non-life insurance it is only in life assurance that such reporting occurs widely in a statutory form. The system has worked well in life insurance and is clearly a lead that we as non-life actuaries can follow, showing that we too have something unique to offer. There has been considerable discussion in the UK as to whether there should be a statutory requirement for an Appointed Non-life Actuary but as yet no decision has been made. Non-life actuarial reporting can range in scope from an opinion on the quantum of technical claims reserves at year-end on business already written to responsibility for an insurance company being financially sound in its entirety, including whether new business rates are adequate.

Three distinct areas were considered in preparing subject matter for this Session:

- What the role of the actuary should be,
- To discover what progress other countries had made in actuarial reporting,
- The role of actuarial associations in different countries, especially as regards actuarial reporting.

Historically insurance supervisors have used simple methods to calculate minimum solvency requirements. More sophisticated methods have now been developed. RBC (Risk Based Capital), DST (Dynamic Solvency Testing), and simulation work carried out in the UK and Scandinavia have shown how actuaries are looking to improve their skills and to assist the supervisors. RBC methods, as used in the USA, involve considerable assumptions as to the methodology and to the parameters to be used. Some of the results from using these methods have been quite unexpected. Criticisms of RBC as used in the USA include:

- Risk factors initially calculated based on worst-case scenario rather than most likely,
- Small companies penalised by special additional loadings,
- Contracts where premiums are adjusted based on loss experience are not given due credit,

- Asset factors are those that were developed for life assurance,
- Insurers may be forced to perform to specifically meet RBC requirements and this may not be in the best interests of policyholders.

PALMGREN and BERG emphasise the benefit that many parties derive from good actuarial reporting. They point to uniformity of standard reporting including definitions and parameters used and concentrate on the experience, exposure and economic aspects of actuarial reporting. The role of the actuary will become far more important as insurance becomes more complex and international.

Should actuaries from all countries get together to maintain higher and consistent reporting standards?

The papers presented show the current situation in Eastern Europe, France and the UK. Brief reports on actuarial reporting in Nigeria and Bulgaria (very little!) were presented, together with the current situations in the USA and Australia.

VARGA describes the development of insurance in Hungary, including certain aspects of the State Insurance Supervisory Authority and that part of the new insurance law defining the role of the chief Actuary.

DAYKIN concentrates on the development of the actuarial profession in Central and Eastern European countries. In the course of privatisation, the insurance industry has faced severe problems. The role of the actuary in helping to solve these problems is of great interest.

The paper by BELLANDO translates as State Control in France for Insurance. The role of the Commissioner Controller is to constantly oversee insurance companies and is essentially an actuarial role. The system appears to work satisfactorily.

SCURFIELD describes the current UK situation and its history since the start of non-life actuarial involvement about 25 years ago. Much has happened in the UK over the last two or three years including statutory responsibility in limited fields within Lloyd's and the USA NAIIO involvement. Guidance to actuaries is provided by the Institute and Faculty. Statutory actuarial reporting would provide a number of benefits.

In Canada the route has been towards DST. Some questions are whether these methods should be approached by simulation or deterministically, has Canada, got it right, or has the move to a regulatory role for Canadian actuaries been too quick? The position in Canada is believed to be a possible guide to the future for many countries. In general every insurance company federally registered in Canada is required to have an appointed actuary. There is no difference in the appointed actuary's statutory responsibilities whether it be for a life or non-life company. The new act imposes an obligation on the Actuary to report on the year-end financial position and the regulators have said they will request future financial condition reports for some non-life companies (using DST). The Canadian Institute of Actuaries is pushing aggressively to have regulators adopt discounted reserves simultaneously with an explicit provision for adverse deviation.

This session gives an opportunity for actuaries to be involved in the most practical of matters, their communications with the outside world. As a profession we are on the verge of having a major input to the insurance industry world-wide. We must not miss this opportunity. We must bring added value to the insurance industry and be a credit to our profession.

### **Session E: Speaker's Corner**

Seven papers were presented in this session, including three which had not been circulated prior to the colloquium. As might be expected, these papers were diverse in their subject matter.

GERBER and SHIU show that the Esscher transform is an efficient technique for valuing derivative securities if the logarithms of the prices of the primitive securities are governed by certain stochastic processes with stationary and independent increments. Formulae are given for the pricing of European call options, and it is shown that the celebrated Black-Scholes option-pricing formula can be derived using this method. KLIMKIEWICZ shows that Bühlmann's classical credibility model is equivalent to a classical linear model and uses results relating to the estimators of variance components in linear models to show that the generally used estimator is optimal in the class of unbiased invariant quadratic estimators. LABIE, GEERARDYN and GOOVAERTS consider a modified Brownian motion process as a model for the surplus of an insurance portfolio. They take account of the effect of control activities forcing the surplus level upwards and the influence of dividend payments pushing the surplus downwards. The distribution of the surplus at time  $t$  is derived under the assumption of no ruin. PARKER presents two approaches to the modelling of interest randomness, namely modelling the force of interest accumulation function and the modelling of the force of interest directly. The expected value, standard deviation and coefficient of skewness of the value of immediate annuities are presented as illustrations. BOSKOV and VERRALL give a method for premium rating by postcode area, based on spatial models in a Bayesian framework. A wide range of models within this class are suitable for use with insurance data, wherever there is a geographical area effect. KREPS and STEEL describe a stochastic planning model for an insurance company, where the variables are connected by simple econometric equations whose form and parameters are generated by the data. The model gives surplus requirements as a function of both risk appetite and management scenarios. As a by-product, a stochastic model of loss development is generated. PETAUTON investigates the lower bounds for the distribution function of a positive random variable.

### **ASTIN General Assembly**

G. Willem de Wit, Netherlands, who had been a member of the ASTIN Committee since 1985 and whose merits and work for ASTIN were acknowledged by the chairman, expressed his desire to resign. Bouke Posthuma,

Netherlands, was elected as his successor. Furthermore James MacGinnitie, USA, was welcomed as a new member and as one of the appointed IAA delegates on the ASTIN Committee.

It was announced that the next ASTIN Colloquium would take place in Cannes, France, on 11-15 September 1994. The main topics would be

- the financial stability of a non-life insurer;
- risk selection and the setting of premium rates;
- the analysis of major variations in loss experience.

Some discussion took place on the language difficulties which might be faced by those whose native language was not French, and ways of overcoming this would be investigated.

The following ASTIN Colloquium was expected to take place in Belgium in 1995, probably immediately following the Centenary International Congress to be held in Brussels.

The task force considering possible new formats for colloquia would continue its work, and would take account of suggestions made by delegates.

A prize had been instituted by the CAS to commemorate the work of Charles A. Hachemeister, with the intention of encouraging North American actuaries to become more familiar with ASTIN literature. It would be awarded to the colloquium or bulletin paper which was considered most beneficial to North American actuaries.

### **Social Programme**

On Monday evening, participants and their accompanying persons were invited to an organ recital in St. John's College Chapel, followed by dinner in the college dining hall.

On Tuesday there was a full day excursion which began with a walking tour of the Cambridge colleges. Coaches then arrived to take us to the Great Barn at Chilford Hall, a restored barn complete with vineyard. Lunch was served accompanied by the local wine, which was also available for purchase if desired. The afternoon offered a scenic ride through the Suffolk countryside to the medieval wool village of Lavenham, and the opportunity to explore the village at leisure before returning to Cambridge.

On Wednesday evening a drinks reception in St. John's college preceded the gala dinner and dance in the Corn Exchange, which offered good food and wine, a convivial atmosphere, and music and dancing late into the night. John Martin, President of the Institute of Actuaries, gave a witty and entertaining after dinner speech.

Between or after the conference sessions, various delegates were spotted enjoying other traditional Cambridge pursuits, notably punting and croquet.

Sincere thanks are due to the organising committee and the staff of the Institute of Actuaries for their unstinting efforts to make the colloquium such a success both scientifically and socially.



Having recognised that even in July the British climate cannot be relied upon, the organisers thoughtfully arranged for each delegate to be equipped with an umbrella, courtesy of a well known firm of consulting actuaries. This forethought was appreciated during the walking tour of Cambridge, but the umbrellas also became quite a talking point, as will be seen from the following poem contributed by Bjorn Sundt :

What shall I do with my umbrella  
 When entering a plane  
 Or climbing out of a train?  
 Say, what shall I do with my umbrella  
 It's always on my mind  
 Where shall I find  
 A place to put my umbrella?

On registering they tell us  
 That we would need umbrellas.  
 They gave us blue and white ones,  
 But I'm not sure they're right ones.  
 I have some sort of feeling  
 That they are not appealing.  
 I'd rather call them ghastly.  
 They're long and Tillinghastly.  
 Although I might be wrong,  
 I'll sing my present song.

What shall I do with my umbrella?  
 It's so long, it's so bright.  
 I can't get that bloody thing out of my sight.  
 So what shall I do with my umbrella  
 For heaven's sake  
 Why do they make  
 Such an enormous umbrella?

CAROLINE BARLOW, GRAHAM LYONS

#### APPENDIX A

##### *"Wider Horizons for Actuaries" – Sir Brian Corby*

In considering the possibility of expanding the areas of actuarial involvement, it is appropriate to reflect on how long it has taken to achieve the current level of involvement in non-life insurance. It is also appropriate to give a word of warning—the presentation of our results and ourselves is important, and it is vital that we should express ourselves in terms which are clearly understood, avoiding mathematical complexity. However interesting the theoretical probability distributions might be, it is necessary to address practical questions—how likely is an event to happen, what is the cost if it happens, and what other consequences will there be?

Actuarial science is unique in combining probability and compound interest, and this should be of wide applicability, since all human activity involves risk. Why therefore is there not wider actuarial involvement, and what opportunities exist for actuaries to widen their sphere of influence?

In the 6th annual lecture to the Geneva Association given in 1982, Professor Raymond Barr posed the following question: "We are living in a world where uncertainty is growing and risks are becoming ever more extensive. At the same time we note an upward trend in the demand for security. To what extent can the demand for security be met by the state without slowing down or hindering the adaptations made necessary and inevitable by the far reaching changes in the world?" This question concerns a choice for society, between security and progress.

At the same time, there is pressure for greater competition, more choice and a better deal for the consumer, but greater competition and choice implies greater risk, and there is thus a conflict between competition and risk aversion. There can be no absolute resolution of the conflict—it must be managed by the government, politicians and the public generally.

Against this background, a better understanding of risk—and of the fact that a risk free environment is impossible—is vital to society. Without this understanding, the process of protecting the consumer, particularly when the supply of goods or services goes wrong, can easily lead to those goods or services ceasing to be available.

It is interesting to consider people's perceptions of risk. The Royal Society study group on risk defined risk as "the probability that a particular adverse event occurs during a stated period of time or results from a particular challenge" where an adverse event is "an occurrence that is producing harm". In relation to attitudes to risk, they concluded that "scientific determinism has replaced religion and magic as the way in which many ordinary people explain adversities and one consequence is that there is generally a search for causes and an attribution of responsibility or blame. These attributions lead to important differences in perceptions and there is urgent need for research in this area". A further finding was that "At the more strategic levels, risk management is an essentially political process informed by technical estimates" and it was recommended that both the public and technical specialists should be involved in discussion and in the regulatory process with a view to achieving a more balanced approach to the existence of risk.

People's perceptions of risk often reflect subjectivity rather than an unbiased probabilistic assessment. This is illustrated by a Swedish report which commented that between 75% and 90% of car drivers consider themselves to be driving better than the average driver!

It is certain that failures will occur in the future, as they have in the past. It is important to recognise the dilemma between freedom and the desire for security, and failure should not necessarily cause us to call for changes in the system, which may nonetheless have worked well.

Perceptions of aggregation of risk must also be considered. A single disaster affecting a large number of lives is far more likely to lead to political action than a large number of smaller incidents.

There is a clear need for a better educated public and for the application of common sense. Politicians and the public must accept that zero risk is not attainable, and it is not possible to guarantee that adverse events “will not happen again”.

It is important to recognise that there comes a point where the advantages of increased safety are not worth the restrictions which would be imposed. Risk is inseparable from a democratic society, since democracy implies choice which in turn implies risk. What is needed is the understanding and management of risk. The actuarial profession has a part to play in both of these aspects. It clearly has a role in relation to insurance, but its potential role is wider than that.

Insurance does not consist of selling security but rather of providing the means to manage uncertainty. Unfortunately, it appears that the limitations of insurance are not understood by the government or the public. One problem is that of moral hazard—the insurer and insured should be equally risk averse. Also, insurance may not be the solution where either the premium required would be too high to be socially acceptable or where the risk is very low but the cost if a loss occurs is very high. There is no counterpart to the “banker of last resort” for insurance, and this reinforces the view that certain risks are uninsurable.

The role of actuaries outside insurance will relate to the assessment of risk in other fields such as the evaluation of capital projects and, more significantly, the partial transfer of social security costs to the private sector. The private sector is likely to be keen to expand its business, but must be aware that there are limits to insurability. Enthusiasm must not lead to the acceptance of risks which cannot be insured against—particularly the uncertainties associated with inflation.

In conclusion, actuaries have a role to play in bringing about a better understanding of risk and contributing to a better informed society. At the same time, there is an opportunity to broaden the scope of the profession.

## APPENDIX B

### *Lecture by Hans Bühlmann; Claims Reserves: Theory and Practice*

Consider the origin of claims reserves. If an insurance claim occurs it entails a payment stream. The payment stream is the natural notion whereas claim amount and incurred claims are derived and somewhat artificial notions. From this it can be seen why reserving is a problem. It involves finding good methods for estimation of reserves. The functions used in non-life are comparable with the corresponding functions in life insurance.

The concept of a *window* is useful, the familiar triangle being the visible window with the variables outside the window requiring estimation. The actual paid and cumulative paid triangles are truly observed triangles, the incurred claims triangle itself being the result of estimation.

Considering the flow of claim payments for one accident year, what is required is to estimate the values outside the observed window, i.e. for future

years. This is only possible if we say what we mean by our estimate and its purpose. It is observed that only the sum of the future payments is needed, and that as this is a random variable, depending on the purpose of our prediction we may use different predictors, e.g. the mean, the median, a confidence interval, etc. What is being considered here is the *conditional mean*, i.e. given all information available to date.

The life actuary is much more interested in *time points* of payments using the axiom of “*Time is Money*”. For him it is as equally important to calculate total future paid claims as the discounted value of future claims.

The following set of rules should be followed:

- a) State clearly for what purpose the reserve calculation is needed.
- b) State clearly how profits must be measured depending on the choice for the reserving methodology.
- c) State clearly how the reserves should be financed.
- d) Your managing director, having understood a), b), c), should choose between the undiscounted and discounted reserve options.

Ignoring the question of discounting, the essentials of any reserving methodology are:

- Describe the stochastic model underlying the calculations,
- Define the method of estimation,
- Discuss reliability of data and of results.

Concentrating on the first of these, using either the paid or incurred claim triangles, stochastic modelling is considered. Practically all such models can be written as regression models. The random variables  $\varepsilon_i^{(m)}$ , the disturbances in the claims process for accident year  $m$  at time  $i$ , are introduced, and used to define optimal solutions using expected square deviations. The models considered with their underlying stochastic models, are:

1.  $AR_1$ -models on cumulative claims only: Chain Ladder, London Chain Ladder and London Pivot,
2.  $AR_1$ -models including exposure: Simple Loss Ratio, Complementary Loss Ratio, Bornhuetter-Ferguson, Cape Cod,
3. Straightforward Extensions of 1:  $AR_1$  replaced by  $AR_p$ , Explicit use of collateral knowledge,
4. Advanced Reserve Models: Factor Models, Curve Families.

We as actuaries should be particularly aware of the possible weakness of statistical methods, e.g.:

- It has been suggested that the effect of grouping of data is that any reasonable method applied to the two parts when a combined portfolio is split will yield a higher total reserve than the same method applied to the combined data. The results of some experiments to test this hypothesis have shown that it is not justified in practice.

- Many methods make *implicit* allowance for inflation. It is probably more reasonable to do this *explicitly*.
- It is impossible to make allowance in the reserving process for *unforeseeable events*.

Having covered how in theory claims reserves should be assessed, we then come to the practice. Reserving strategies can be used, for example, to either build hidden surplus or, alternatively, to show more favourable results than competitors. The gap between theory and practice is therefore between the *actuary* and the *managing director*.

Several principles learnt from life insurance are:

1. Ability to reproduce Claims Reserve valuations,
2. Normative Role of the Actuary,
3. Public Function of the Actuary.

The following proposals are put forward:

1. For the Actuary:
  - Accept the normative rôle we have to play in insurance,
  - Create a culture in claims reserving based on open communication.
2. For the Industry:
  - Create or extend a rating agency system on a world-wide basis,
  - Define non-government solvency standards, for solvency margins and reserve strength,
  - Extend the previous two proposals to all aspects of financial risk,
  - Support and encourage the rôle of the actuary as an independent moral and scientific force, on which one can build the long-term stability of insurance.

## APPENDIX C

### *List of papers*

#### **Session A: Rating (Pure)**

S. M. COUTTS, E. R. DEVITT & N. SHAH  
Financial Control in a General Insurance Operation

C. DENGSOE & C. LARSEN  
Customer-based Rating

J. LEMAIRE  
High Deductibles Instead of Bonus-Malus: Can it Work?

G. C. ORROS & C. T. PETTENGELL  
An Interactive Underwriting Model for Premium Rating by Geographic Area

S. HOLM & T. HOYLAND

Rating the Risk of Bodily Injuries in Motor Insurance

F. KRIETER

Rating the Partnership Clause

D. SLEE

The Theory and Practice of Modern Rating Techniques

D. DANNENBURG

Some Results on the Estimation of the Credibility Factor in the Classical Bühlmann Model

B. KLING

A Note on Iterative Non-Linear Regression in Credibility

R. SCHNIEPER

On the Estimation of the Credibility Factor

### **Session B: Reinsurance**

G. BENKTANDER

A Stop Loss Rating Formula

W. HÜRLIMANN

An Insurance Market Based Distribution free Stop-loss

R. KAAS

How to (and how not to) Compute Stop-loss Premiums in Practice

C. MIRANTHIS, J.P. RYAN & L. SALVATORI

Constructing a Reinsurance Programme for a Captive Insurance Company, Using Simulation Techniques

R. HIRASE

Notes on Catastrophe Reserves on Non-life Insurance in Japan

D.H. CRAIGHEAD

The Design of Catastrophe Reinsurance Programmes: Practical Problems

D.E.A. SANDERS

When the Wind Blows – An Introduction to Catastrophe Excess of Loss Reinsurance

D. HINDLEY & A. SMITH

Quantitative Analysis of Financial Reinsurance

P. DAHL

Expected Utility and Optimal Shares of Reinsurance Treaties

E. KREMER

A Probable Maximum Loss Theory

MARIA DE LOURDES CENTENO

The Effect of the Retention Limit on the Risk Reference

**Session C: Rating (Reserving)**

O. A. SVENDSEN

A Deterministic Method for Claims Reserving in Non-life Insurance

B. AJNE

Additivity of Chain-ladder Projections Revisited

R. J. VERRALL

Chain Ladder with Varying Run-off Evolutions

T. MACK

Which Stochastic Model is Underlying the Chain Ladder Method?

R. NORBERG

Prediction of Outstanding Liabilities III: Parameter Estimation

O. HESSELAGER

A Markov Model for Loss Reserving

A. E. RENSHAW

Modelling the Claims Process in the Presence of Covariates

C. PARTRAT

Compound Model for Two Dependent Kinds of Claim

**Session D: Reporting**

B. PALMGREN & M. A. BERG

Experience, Exposure and Economics

T. VARGA

The Development of Non-Life Actuarial Reporting in Hungary

C. D. DAYKIN

New Challenges for the General Insurance Actuary in Central and Eastern Europe

J. L. BELLANDO

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