

INTRODUCTION

The purpose of this note is to stimulate and guide a discussion scheduled to last for three hours. Its aim, therefore, is to pose questions rather than to answer them; to be provocative rather than diplomatic. I assume a knowledge of the formulae proposed in the DoT's consultative note C.N.7 and its annexes and the current forms of DoT Returns.

SUBJECTS FOR DISCUSSION

Let us first be clear what we are and what we are not discussing. What we ARE discussing is the estimation of the mean and variance of the following amounts

- (1) Amounts still to be paid on claims which have been notified to a company (including further amounts due on claims thought to have been finally settled).
- (2) Amounts to be paid in respect of claims that have arisen but have not been notified to the company.
- (3) Liabilities in respect of the unexpired period of insurances where cover continues into the future.

In certain circumstances (1) and (2) may appear as a single figure (as for example in the C.N.7 proposals). Item (3) involves liabilities for continued cover to the next renewal or, if the insurer goes into liquidation, up to the date of liquidation; in the latter case there will be a liability for a return of premiums for the period from liquidation to next renewal.

The variance must take into account random fluctuations in the number and severity of losses, fluctuations in monetary values arising from inflation or currency changes and the changing ideas on levels of compensation whether arising from changes in law (interest on damages or no-fault liability) or changes in judicial practice.

We are considering not merely the mathematical expression of various matters, but also the estimation of numerical values of the parameters involved and the data recording and processing necessary to estimate, and to verify past estimates of, those parameters.

It is also highly desirable, in the light of the discussions on supervision, to bear in mind the extent to which any method we develop may be satisfactory for an auditor or supervisory authority who has to test the validity of our bases and the accuracy of our calculations. A method suitable for a company with adequate and regular testing of all its data may by itself be totally unsuitable for an auditor or supervisory authority solely on account of the difficulty in testing the bases of the calculations, or the data to which they are applied, or both.

What we are NOT (at least directly) concerned with, is the problem of supervision, the calculation of actual solvency margins, or the proper basis for fixing statutory minimum solvency margins, although we should aim to provide the raw material to assist in the discussion of those matters.

We are NOT in this session concerned with the making or interpretation of statutory returns, nor their form, although we should aim to provide some, at least, of the data which will be required when these matters are discussed.

Finally, and most importantly, we are NOT concerned solely with motor and particularly NOT with U.K. private motor only. Nor are we restricted to mathematics and statistics since many factors will depend on judgment of future trends.

PRELIMINARY OBSERVATIONS

If the actuarial profession is to make a serious claim to be considered as having a contribution to make to non-life insurance matters, it must recognise, inter alia, that

- (1) Motor business world wide accounts for only about one-third, and U.K. private motor for less than one-tenth, of the world wide non-life premium income of the U.K. insurance company market. If Lloyd's business is included these proportions are reduced to about 25% and 7% respectively.
- (2) Very little serious statistical study has been made by U.K. actuaries of anything outside the U.K. private motor field and little statistical study based on adequate data relevant to the operation of U.K. insurers seems to have been made by Continental actuaries. It is imperative that we widen the scope of our discussion to bring in all forms of non-life insurance.
- (3) There are many types of business that do not lend themselves readily to statistical analysis, and there are areas, even in U.K. private motor business, where other matters, (for example the scope of reinsurance arrangements) may be more important than the estimation of gross liabilities, especially for smaller companies.
- (4) The one matter in which an actuary claims a special professional expertise is the combination of compound interest and probability. There is little of either in non-life insurance; where they may be relevant, as in the random incidence of large claims taking a long but uncertain time to settle, it is likely that reinsurance arrangements may so damp the oscillation at the net level that the statistics of large claims are relatively unimportant in fixing a net technical reserve.

We must in my view limit our claims to be considered, to those areas in which we have something special to offer. I do not exclude the claim that, being a small profession, all of which is trained in the necessary data handling and assessing techniques, we do therefore have experience, as well as a professional obligation to honour, that makes it suitable for us to assess the results of various matters and to apply such statistical tests as may be appropriate. As a consequence we may claim the right to be allowed to give professional certificates. The question as to whether we can certify for an employer is outside the scope of this morning's discussion.

- (5) We need to co-operate with those accountants who have shown some insight into the nature of the problems. Whilst they may be in a minority in their profession, the Institute of Mathematics seminar revealed that there are some whose thinking is well advanced.
- (6) Methods devised for life insurance may, or may not, be useful in non-life. It must be recognised that there are fundamental differences between the two forms of insurance and attempts to force non-life techniques into the same mould as life have often been quite inappropriate. Among the important features of non-life insurance are:
  - i) more than one claim may be made on a policy during a given period of cover;
  - ii) the amount payable may be very large in relation to the premium and may in some cases have no upper limit;
  - iii) the amount of a claim is often unknown until long after it has arisen;
  - iv) interest is of relatively little importance in connection with individual policies, although it is taken into account in fixing overall premium levels and may have a significant influence in some classes of insurance;

- v) the nature of the contracts and the types of risk are extremely varied;
  - vi) insurances are world wide and well over half the amount paid out in claims by U.K. insurers is in currencies other than sterling.
- (7) There is an urgent need for all those who do not have access to an adequate source of data and a knowledge of the normal practices of the non-life insurance industry to have an opportunity to learn enough of the problems of data collection and assessment and of other matters connected with the conduct of the business to enable them to make contributions that are relevant to the subject. The fact that this category seems to include much of the profession and perhaps the entire supervisory authority makes this need particularly urgent. It is up to the major non-life companies to give a lead, even if this means abandoning some time-honoured (or dishonoured) practices.

#### MARGINS

In life insurance it has been customary to allow a margin in the various parameters used in a valuation basis and to assume that these collectively provide a sufficient buffer against adverse fluctuation. This is, no doubt, satisfactory, at least in with-profit life business having large bonus loadings, where sums assured can be adjusted from time to time over a wide enough range to be able to cope with most difficulties and, in most cases to cover also losses on fixed annuity and other non-profit business. In non-life the position is entirely different. The amount payable, far from being adjustable at the whim of the insurer is to a large extent outside his control and subject to various influences noted above as contributing to the variance. In my view we ought to put all our margins into the variance and aim to estimate the mean without bias, allowing the variance to cover all the factors which may affect the final liability.

It cannot be too strongly emphasized however that this does NOT imply that the mean should be adopted as the technical reserve in published accounts. There are clear arguments in favour of having published technical reserves that are higher than the mean, but if so then the minimum solvency margin required could be lower than it otherwise would need to be. Our task is to ascertain the facts; their presentation in accounts is a managerial function.

#### LIABILITIES IN RESPECT OF COVER ALREADY GIVEN

We have to estimate payments that are to be made in future and the recoveries from reinsurers, from other insurers under sharing agreements or from other persons.

The first obvious thing to do is to find out how such payments and recoveries have taken place in past years.

How long a period do they cover?

Do they comprise a large number of small payments giving rise to a steady rate of outgo or do they arise in a smaller number of large payments perhaps at random intervals?

Is there a seasonal pattern?

Is the rate of outgo (as a percentage of the total for one cohort of claims) steady from one cohort to another or does it vary substantially?

To what extent is the gross pattern affected by reinsurance recoveries or other recoveries?

Would it help to work on a net basis for some or all classes?

Can we segregate the business into a small number of types or groups within each of which patterns of payment are similar and can be used for predictive purposes?

Can we relate payments to cover given or premium earned or the premiums that would have been earned on a given premium scale?

How can we introduce judgment in respect of

- i) changes in portfolio mix
- ii) changes in the cover given
- iii) changes in policy conditions
- iv) changes in inflation rates
- v) the incidence of national disasters or major losses
- vi) changes in the rate of payment from whatever cause?

My own view is that we cannot hope to answer any of these questions without ample data in regard to payments in past years. Whether such data are adequate by themselves to forecast the future is far from certain and even though C.N.7 assumes they are, it is, so far, completely unproven.

How many companies have these data with sufficient breakdown by class and country to be of value?

How many have them even for the U.K.?

How many have them even for U.K. private motor?

Can anyone suggest how we can measure the reliability of using the past as a guide to the future without such data?

Will those present give a brief note of what data their own companies have and could make available?

Will they, in fact, make such data available?

To the extent that random fluctuations give our estimates of the future an undesirably high variance, how are we to proceed?

Estimation of individual cases?

Estimation of some cases, in a random or stratified sample?

Estimated total payments less those already made?

How can an actuary verify such estimates both for bias and variability?

In appendix 1 I give some figures for typical types of business of which I consider three broad kinds

- (a) Property: Here the run-off is generally quite rapid and the liabilities seem capable of fairly reliable estimation by traditional methods. For this class the outstanding liabilities are a relatively small proportion, perhaps 15% to 20% of earned premiums so that even quite large proportionate errors will not have a major effect on solvency margins.
- (b) Motor and Consequential Loss: Here the run-off is slower and even at the end of five years there is still about 3% to 5% of total claims to pay. For this class the total outstanding liability is probably of the order of 50% of earned premiums, so that errors in estimating can have a fairly important effect on the apparent solvency margin.
- (c) Liability: Here payments continue at least to the ninth year and even longer where professional indemnity is involved. The liabilities can amount to 2½ to 3 years earned premiums with even more in some cases. Excess of loss reinsurance probably behaves in a similar way.

If we express our solvency margin in terms of earned premium then an error of 5% (of the earned premiums) might be expected if the errors in estimating technical reserves were 25% to 30% for property or 10% for motor or 2% for liability. This surely gives some clue first as to where our efforts should be most directed and secondly to the need, when we come to consider supervision, for having different treatment and, no doubt, different levels of solvency, for different types of company.

However, it may well be that the reserves actually required as distinct from the amounts normally calculated, for unexpired risks may be found to be most variable for property and least for employer's liability simply because of the random incidence of major natural disasters such as windstorms, floods or earthquakes.

#### PROPERTY

I see little scope for statistical analysis. Our own company's experience, and the returns made by other companies under the 1968 Regulations, suggest that existing estimating methods are reasonably adequate; the amounts however seem so variable from year to year that I doubt if statistical analysis based on past patterns would be anything like as good as traditional methods. In Domestic Insurance, however, it may well be convenient to use a little statistical help by taking a count of the number of small claims, defined in some precise way, and assume an average amount for these claims based on experience. Unless the labour involved in present methods is excessive I doubt if the profession has much to offer here.

Can anyone provide from his own experience or the data of his own company, a confirmation of this view?

Can anyone suggest improvements that the profession can make and if so can he substantiate his claim?

If other methods are suggested would they be valid for a supervisory authority to use as a basis?

Can anyone provide data to illustrate the effect of natural disasters either in the U.K., or U.S., or generally?

#### MOTOR AND CONSEQUENTIAL LOSS

These obviously cover many types of peril ranging from theft from cars and damage to the car itself, to damage to other cars and to other property, as well as to bodily injury.. Consequential loss covers, inter alia, material losses and loss of profits. The distributions of payment amount and rate clearly differ from one peril to another and the mix of perils varies quite a lot within the class.

For motor, comprehensive, I think the rate of outgo in the first two or three years or so may not be very much affected by variation from random fluctuations of claims incidence. It is however liable to be affected by staff shortages, slowness in getting spare parts, fluctuations in used car prices, and could be slowed down if the company was short of money.

For third party liabilities, especially bodily injury, random variation is clearly more important than for accidental damage, but there are many other influences including, in the past, interest on damages; in the future changes such as no-fault liability; and from time to time changing judicial attitudes to the assessment of damages.

For consequential loss I have little information. Can anyone provide data and any more detailed observations on these matters?

Having obtained some data we must then turn our attention to using them for estimating outstanding amounts.

The reserves can conveniently be divided into three groups

Group i) Claims arising in the latest year. These amount to roughly half the total reserves if the business is reasonably static so that errors in these estimates will have an important influence on the total liability. A large part of this liability, however, arises from quite recent and I.B.N.R. claims about which we have little or no information other than what may be inferred from the experience of earlier years supplemented by judgment in relation to any change in the portfolio or claims incidence.

Group ii) Claims four years or more old. The size of random fluctuations is so large that individual case estimating is almost certainly essential. The errors involved in using grossing-up methods (either chain ladders or other methods involving percentage paid) or in taking an assumed claim amount times the number of claims less payments on account, are likely to be proportionately very large.

It is most unlikely that statistical methods can supplant individual case estimating and the work involved in case estimating is likely to be relatively small and since it will give rise to a review of all outstanding claims it is probably administratively desirable.

For motor, the total liability for such claims is probably not much more than 5% of the total liability for this class, (unless the business is contracting very rapidly) so that errors are not likely to have a major impact on solvency margins and no problem seems likely to arise either for a company or a supervisory authority. For a small company with an excess of loss treaty at a fairly low excess point the net amount may well be trivial.

Group iii) Claims 1, 2 and 3 years old. These contribute about 45% of total liability and seem suitable for some statistical estimating process, but supplemented to at least some extent by case estimating. Most notes so far circulated seem likely to be appropriate only for this group if anywhere.

Let us discuss the three groups separately.

Group i) Consider the indicators that may enable us to compare the year just gone with earlier years. These include :

The average amount for which a claim has been settled (weighted average if the business is growing rapidly or has pronounced seasonal patterns or some exceptional events have occurred),

The average amount of a cheque issued.

The number of payments related to the number of claims notified (weighted as above where necessary).

Ratio of actual to expected claims, using a standard table technique.

Information regarding changes in policy conditions, including NCD scales and pattern of voluntary excesses, change in portfolio mix, national road accident statistics (or fire losses in case of consequential loss), scales of compensation for injury, legal rules for compensation.

If any of the changes listed in the last paragraph apply we cannot assume that the pattern of later payments in relation to earlier ones is unchanged. In case anyone says it will not matter much let me remark that in private motor in the U.K. in 1967 and 1968 the combined effects of breathalysers and other safety measures, new NCD rules and windscreen claims mostly being allowed free of NCD penalty, were such as to maintain the number of claims at a fairly steady level but to reduce the average cost of a claim notwithstanding the inflation which occurred in those years.

How to establish exactly what is happening is not easy. I have experimented by asking claims staff to code certain cases as "serious" in an attempt to monitor the incidence of the potentially larger claims, but it is clear from the results of the first three years that one major problem is to get the staff to remember to put the code on at all; even when they do record it, it is not easy to be sure that they have done so in a consistent manner. Has anyone any suggestions to offer as a better way of monitoring changes in the claim pattern?

We need to discuss the underlying facts and the reliability of using the past, without amendment, as a guide to the future. Chain ladders, the formula in the consulting actuaries' note to the DoT, that in the Institute memorandum, and curve fitting processes are merely slightly different ways of doing the arithmetic based on largely similar assumptions. There has been too much discussion of the formulae whereas what matters is the basis.

It could be that if we can be reasonably satisfied that the earned premium was adequate then the best estimate of the reserve might be

Earned Premium

- Commission
- Expenses
- Payments to date

Can anyone suggest anything better? If we suspect the premium basis to be inadequate we can, if we keep proper records, re-calculate earned premium on a proper basis. How we establish what the premium basis should be depends, in the end, on much the same sort of subjective judgments as we have already considered. We are, as often, going round in circles.

Group ii) Has anyone anything to add to what I have already said?

Group iii) When we come to years 2, 3 and 4 we have more information in regard to the development of claims to date, but, especially in years 2 and 3, we still lack information on the relation of the large B.I. or similar claims to the smaller injury or other property damage claims. In the case of consequential loss I have no information as to the relation between the longer delayed claims and the shorter ones; does anyone know anything about these?

One method which has been adopted in motor is to compare the ratio of the amount paid in respect of each year of claim with the corresponding figure for the previous year of claim developed for the same period. This suffers from the usual defect of chain ladder or grossing-up in that slowing up of payments gives the wrong answer.

We have made some adjustments for the proportion of claims settled by number taking the amounts paid on settled claims at times when the same percentages of all claims have been settled as in the previous yearly cohort. The trouble is, however, that "settled" is not easily defined in a meaningful way and the relation between the payment of money and the treatment of claims as settled may be variable.

We define settlement date as the day a clerk sends the file to Chief Office as "closed". This is at least an objective test, but if a branch clerk is away or if we are waiting for his replacement the "date of settlement" can vary from branch to branch, so that some bias is introduced into the total figures for all branches of an insurer.

Can anyone think of a better definition of settlement? The date of last payment is no help since in many cases this is not known until long after the event where, for example, potential liabilities do not lead to actual payments.

Will members be prepared to say how their companies do the estimating and whether they use the same risk groups as they do for the DoT returns?

Will they say whether the same methods are adopted in all countries; whether recent changes have been made; whether they monitor the results by cohort and if so the results of that monitoring; whether the DoT returns in the C.S.A. agree with those adopted in the audited accounts? As this could cover a lot of paper will they be willing to circulate it to the conference?

#### LIABILITY AND EXCESS OF LOSS REINSURANCE

The problems here are of a similar nature to motor and consequential loss, but the scale is somewhat different. The newest claims (group i) where little is known, cover from two years to as much as five years according to the nature of the business, and probably even longer for excess of loss cover with high excess points. The liabilities in respect of these years of claim may however amount to as much as 1½ to 2 years earned premiums so that errors in their estimation will have a serious effect on the actual solvency margin of the company. Natural fluctuations are likely to be large and to give rise to the need for correspondingly large minimum solvency margins.

For the first two years of development I see little prospect of improving on the basis of premium less commission, expenses and payments to date, although with some of the very high loss ratios recorded in these accounts in recent years this could be inadequate. Where liability is an important class for a company the consequences can be serious and a reinsurer with a proportionately large excess of loss business could be in a similar position. I doubt if payments to date are of any value whatsoever here. For the oldest claims (group ii) we are, I think, restricted to individual case estimating subject to a monitoring process.

For claims in the middle range (group iii, say three to eight years) we could use methods similar to those suggested for motor and consequential loss, but I suspect that the definition of timing of "settlement" would be even more difficult and even more critical.

#### DISCOUNTING

For the liabilities likely to be longest outstanding, it is right to ask whether we should use a discounting technique. Obviously fx payable in 10 years is a smaller liability than fx payable now (at least so long as we can invest to produce a positive net return). On the other hand, if all policies



are equally likely to produce long outstanding claims, then the complications of discounting seem to lead to no benefit (in life assurance the situation is rather different since policies are NOT equally likely to lead to equal delays in payment). In practice the failure to discount has given a hidden reserve that has been useful in inflationary times.

In my view all we need to do is to consider the relation of the technical reserves to the premiums and to make a suitable adjustment to the underwriting profit we should aim at (or the underwriting loss that is tolerable). In the other types of business the effects of discounting are likely to be quite negligible.

#### I.B.N.R. CLAIMS

If we rely on grossing-up or a chain ladder based on cohorts defined by accident year or if we use earned premium less outgoings there is no explicit I.B.N.R. problem since the factors, or percentages paid, are related to the final cost of all claims for the year. Otherwise we must estimate these claims.

For U.K. motor we made an analysis of claims by number and amount according to the delay between accident and notification. It was found that there was an average delay of about 22 days by number but only 16 days by amount, since the longer delayed claims were mostly quite small.

An I.B.N.R. reserve was set up equal to  $\frac{16}{365}$  x the annual rate at which total claim liability was arising at the year end. Our analysis for DoT returns now separates claims by both year of accident and year of notification and subsequently, in the light of this analysis, we increased the reserve to about 18 days at the annual rate for motor. Holidays in December and the higher claim frequency around that time seem likely to be the cause of a rather higher than normal rate. It also seems from analyses for the first two years that the actual late notifications at the year end may have a higher average amount than those on average through the year, but random fluctuations and errors in estimates make the results so far rather unreliable.

For other classes of business the process is probably even less exact and for some classes, for example marine and excess of loss reinsurance, the process is likely to be particularly unreliable. Will anyone say what his company does; what steps does it take to test the adequacy of the I.B.N.R. reserves; does it take note of actual notifications in the period between the end of the year and the setting up of the reserve?

#### FUTURE COVER AND CLAIMS

There are three separate and distinct possibilities

- i) to give cover for the remainder of the term
- ii) to refund a part of the premium on cancellation
- iii) to refund a part of the premium on winding up.

The DoT has tended to lay stress on (iii) and to require that as a minimum: assuming that the refund would have to be made gross and that there might be no reclaim of commission or initial expenses. Whilst this is true it will not arise if the company does continue to trade. There may be some confusion of thought here. A company cannot both continue to trade and be wound up.

We need to estimate the mean and variance of the liabilities, including possible losses until a premium scale can be revised, on the assumption of a going concern and, entirely separately, the mean and variance of the liabilities should the company have to be wound up.

To assess the reserves required under (i) we must take as a minimum the proportionate part of the cover on a 24ths or better rule unless a larger amount is required because the cover is increasing, for example with a policy with a built-in inflation factor. The only justification for taking a lower reserve would be in the unlikely event of cover reducing over the period of insurance. We must, however, consider whether we require a larger reserve if the premium basis seems to be inadequate and if the inadequacy is continued beyond the end of the reporting year a further reserve for the losses likely to be incurred before premium levels can be restored. We may also require a larger reserve if the liabilities are seasonal, (hailstorm, hurricane, agricultural tractors). At this point I am inclined to think we need an astrologer rather than an actuary. Everything depends on our assessment of trends and, generally, trends over a period starting some time ago, namely when we were last able to verify what the true risk premium was. Personally, I fail to see what the actuary, as technician, has to offer here: as one exercising professional judgment he clearly has a claim to make, but what this conference can do to quantify it or even lay down rules or bases is, to me, far from clear. Can anyone make any positive suggestions?

#### CONCLUSIONS

As I said at the start of these notes my aim has been to provoke, not to administer soothing syrup, nor to provide solutions. Let us try to establish, for all classes of business and all countries in which business is transacted:

- a) What is current practice?
- b) How effective is it and how well is it monitored?
- c) In what areas can the profession help to improve current practice, or to give equally reliable results more easily?
- d) What can we do to stimulate data collection on the scale and of the quality that will be needed?
- e) How can we, if at all, get any idea of the variance likely to occur in our estimates?
- f) What can we do to stimulate further research and the writing of papers as a basis of teaching and examining?

## Appendix 1

These notes aim to set out briefly the sort of settlement rates and, consequently, the amounts of outstanding liabilities, expressed as a percentage of the total ultimate liability for an annual cohort of claims.

### The estimation of technical reserves, asset values and solvency margins

#### Section 1

Typical rates of settlement, expressed as a percentage of final liability are:

Insurance type	Amounts paid by end of years								
	1	2	3	4	5	6	7	8	9
1 Property Insurance	80	95	98	99	100	100	100	100	100
2 Mixed Insurance (Motor and CL)	60	80	88	94	97	99	100	100	100
3 Liability Insurance	15	30	50	70	80	90	95	98	100
4 Mixed portfolio each type in same proportion	51½	68½	78½	87½	92½	96½	98½	99½	100

This results in outstanding estimates for claims of ages as follows (as a percentage of final liability):

Insurance type	Amounts outstanding at end of years								
	1	2	3	4	5	6	7	8	Total
1 Property	20	5	2	-	-	-	-	-	27
2 Mixed	40	20	12	6	3	1	-	-	82
3 Liability	85	70	50	30	20	10	5	2	272
4 Mixed portfolio	48½	31½	21½	12½	7½	3½	1½	½	127

#### Section 2 Corresponding skeleton balance sheets

	UPR on gross basis				UPR on "40%" basis			
	Insurance type				Insurance type			
	1	2	3	4	1	2	3	4
Gross Premiums	1500	1500	1500	1500	1500	1500	1500	1500
Claims or Earned Premiums	1000	1000	1000	1000	1000	1000	1000	1000
UPR	750	750	750	750	600	600	600	600
Apparent solvency margin (16%)	240	240	240	240	240	240	240	240
Techn. reserves as above	270	820	2720	1270	270	820	2720	1270
Total *	1260	1810	3710	2260	1110	1660	3560	2110

5% error in assets + techn. reserves	76	131	321	176	69	124	314	169
As percentage of gross premiums	5	9	21	12	5	8	21	11
Limits of actual solvency margin on going concern basis (as a % of gross prem.)	21	17	5	14	11	8	- 5	5
	31	35	47	38	21	24	37	27

The last two lines of the above table show the limits within which the true solvency margin will lie on the assumptions of:

- (1) Errors up to 5% in the assessment of technical reserves and asset values in opposite directions.

\* This should be equal to the book value of the assets.

(2) An apparent solvency margin of 16%.

(3) UPR either gross or net of 20% for initial expenses and commission.

### Section 3

It will be seen that with UPR on a gross basis there is a serious risk of calling for very large solvency margins. In fact, if a company wishes to show a solvency margin of 25% then a rule involving or requiring 5% margins in the technical reserve and asset values may require it to maintain a real margin of 45-55%.

On the other hand with UPR on a net basis, a 5% understatement of liabilities and overstatement of assets (a 5% fall in value is quite modest) could lead to actual solvency margins well below 16% at a time when the accounts showed an apparent solvency margin of 20% or more.

We must now ask whether a 5% error in assets and liabilities is an unreasonable assumption. For the time being we assume that we are using a CN7 type formula, applied to all years 1 - 5.

1. If payments at the end of the first year are 2½% down, which is just over one week's payments, then the formula will bring out technical reserves roughly 5% too low in that year followed by excesses of a similar amount on a return to normal. Arrears of this nature, or more, could easily arise from many causes.
2. If a company allocates payments to the wrong year of claim (a practice which an auditor or supervisor would have the utmost difficulty in detecting) errors of 5-10% could easily arise.
3. Changing mix of business, within a class, can have a serious effect on a CN7 type of formula if the class comprises both short and long-tailed payment patterns.

These three effects can be cumulative, so that it is easy to see that the formula could lead to errors in the liabilities well in excess of 5%.

On the assets side it is quite clear from experience over the last ten years that rises and falls of 5% in asset values are well within the likely range.

The extent of the uncertainty arising from various sources is clearly so large as to give rise to serious doubts as to the possibility of ever being able to assess solvency, or the right to continue trading, solely by reference to a solvency margin calculated on traditional lines unless that margin is clearly so large as to make a solvency test unnecessary. It is no use fashioning a test that is liable to fail, or to be fragile just where it is most needed.