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REINSURANCE TO CLOSE WORKING PARTY

REPORT OF THE REINSURANCE TO CLOSE WORKING PARTY

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SUMMARY OF PAPER

This paper follows on from the work presented in the Institute of Actuaries' sessional paper entitled "The Lloyd's Reinsurance to Close Process". In particular, after discussing the way in which reinsurance to close (RITC) premiums are currently set, it considers the implications of the introduction of an actuarial sign-off of the RITC.

Any actuarial sign-off on RITC reserves would need to be on the basis that the reserves were reasonable rather than on the basis that they were adequate. The paper discusses the implications of this for the various stakeholders at Lloyd's. Using the results from a reserving questionnaire, it also considers the consistency between different actuaries in assessing a reasonable provision.

The paper then discusses the appropriate risk margin that should be included in the RITC premium. It considers a number of methods for measuring the variability of claim reserves and includes results to demonstrate the level of consistency between them. It also discusses the issues that need to be considered when setting the risk margin. An assumption that is currently often made by syndicates is that the need for a risk margin is offset by a decision not to discount the reserves. The paper investigates the extent to which such an assumption is appropriate.

The paper discusses the variability seen both between different actuaries' reserve estimates and between the different methods for measuring the variability of claim reserves. It concludes with some comments on the implications of this variability.

Since many of the issues considered in this paper are of equal relevance outside the area of Lloyd's RITC, it is hoped that it will also be of value to general insurance practitioners working outside the Lloyd's market.

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1. INTRODUCTION

For a Lloyd's syndicate, the reinsurance to close (RITC) of a year of account of the syndicate is analogous to a 100% reinsurance of that year of account. A reinsurance premium in respect of one year of account (the "closing" year) is paid by the Lloyd's members on that year of account to a reinsurance vehicle. The reinsurance vehicle is normally the subsequent ("open") year of account of the same syndicate. RITC is usually carried out at a valuation date three years after the start of the closing year of account. Hence, what usually happens is that a year of account remains open for three years and is then reinsured into the following year of account of the same syndicate.

In essence, the RITC premium is paid by one group of Lloyd's members (those on the closing year) to another group of Lloyd's members (those on the year it is being reinsured into) in return for the latter group providing an unlimited run-off reinsurance policy to the former group. Since the managing agent of the syndicate needs to consider the needs of both groups of members, it is necessary for them to set the RITC premium at a level which is equitable to both of them. If the premium is too high it would be unfair to the members on the closing year while, if it is too low, it would be unfair to the members on the accepting year.

There is currently no requirement for actuarial involvement in the RITC process. However, there is a requirement at Lloyd's for an actuary to sign-off on the reserves of a syndicate for solvency purposes. This sign-off is one-sided - in other words, it is on the basis that the reserves are adequate rather than on the basis that they are reasonable. The actuary is required to sign-off separately on the closing year of account, and each of the open years of account. For example, at 31 December 1999, actuaries were required to sign-off separately on the 1993 to 1997 years of account in total, the 1998 year of account, and the 1999 year of account.

A sessional paper entitled "The Lloyd's Reinsurance to Close Process" by Hindley, Allen, Czernuszewicz, Ibeson, McConnell and Ross [4] was presented to the Institute of Actuaries on 27 March 2000. This paper recommended increased actuarial involvement in the RITC process. It considered the introduction of actuarial opinions either on the undiscounted reserves backing the RITC, or on the theoretically appropriate level of the RITC premium. The paper noted that the latter form of actuarial opinion would require consideration of future investment income, and appropriate risk margins. It recommended that more work be undertaken on methods of determining appropriate risk margins in the context of a Lloyd's RITC.

It is interesting to note that the Casualty Actuarial Society (CAS) are also currently beginning to concentrate on the issue of risk margins. For example, the White Paper produced by the CAS Task Force on Fair Value Liabilities (which, at the time of writing, is currently only available in an incomplete draft form [3]) includes a

substantial section on methods of estimating the risk adjusted present value of liabilities.

Our aim was to follow on from the work presented in the sessional paper by Hindley et al [4]. In particular, we have considered some of the implications of an actuarial sign-off of the RITC.

This paper begins with a description of the approaches managing agents currently take to the setting of the RITC premium. This is based on discussions we have held with a number of managing agents.

As discussed above, the RITC premium needs to be set at a level which is equitable both to the members on the closing year and to the members on the accepting year. Because of this, any actuarial sign-off on RITC reserves would need to be two-sided - in other words, it would need to be on the basis that the reserves were reasonable rather than on the basis that the reserves were adequate (as is currently the case with the solvency opinions). In section 3 of this paper, we discuss the implications of this. We consider the effect of such a change on the various stakeholders in the Lloyd's market.

One issue that the profession needs to consider if and when it contemplates an actuarial sign-off on the basis of reasonableness is the consistency of different actuaries' opinions of what constitutes a reasonable provision. In order to assess this, we constructed a simplified reserving exercise which we distributed as a questionnaire to general insurance actuaries and actuarial students. The results are discussed in section 4 of this paper.

We then turn our attention to the appropriate margin for risk that should be included in the RITC premium. This is something that an actuary signing-off on the RITC would need to consider. We have reviewed a number of different methods of measuring the variability of any reserve estimate. These methods are derived from various published papers and could all potentially be used as a basis for calculating risk loads. They are discussed in section 5.

Following this, in section 6, we discuss the various issues that need to be borne in mind when setting an appropriate risk load for the RITC.

Hindley et al [4] surmise that syndicates setting the RITC often currently make an assumption that the need for a risk margin is offset by a decision not to discount the reserves. In section 8, we investigate the extent to which such an assumption is appropriate. Clearly, a theoretically better approach would be to derive an explicit risk margin and then discount the resulting reserves, and using our example from the reserving questionnaire, we have investigated how large a risk load would need to be to exactly counter-balance the effect of discounting. We have investigated this for

each of the methods of measuring variability discussed in section 5 and at a number of different rates of interest.

This consideration of discounting is particularly timely considering the proposals in the 2000 budget for reform to the taxation rules applying to general insurance companies and members on Lloyd's syndicates. These will, in essence, base the tax paid on the discounted value of the claims reserves. The details of these proposals were discussed in an Inland Revenue Consultative Document [5].

The paper ends with some conclusions based on the work undertaken.

It is important to stress that the purpose of this paper is not to recommend appropriate levels of risk loads for RITC purposes, or the methods that should be used to measure the variability of a syndicate's reserves. Clearly these decisions are highly judgemental and heavily dependent on the particular circumstances of an individual syndicate. As such, our view is that they are best left up to the judgement of the actuary or actuaries involved. Rather, the purpose of this paper is to provide some suggestions to actuaries as to the issues they may wish to take into account, and the approaches that they may wish to consider, and to provide them with information to help them to make informed decisions.

While the main focus of our work has been to consider the potential implications of the introduction of an actuarial sign-off of the RITC for Lloyd's syndicates, much of what we consider is of relevance outside this area. Our discussions on the consistency of different actuaries reserve estimates, methods of measuring variability, risk loads, and the offset between risk loads and the effect of discounting are equally relevant to reserving for any other general insurance operation. Consequently, it is hoped that this paper will be of value to general insurance practitioners working outside the Lloyd's market.

2. CURRENT APPROACHES TO RITC

2.1 Introduction

This section of the paper summarises some of the approaches currently being used within the process of establishing the RITC premium. It also highlights some of the issues encountered in practice and considers the involvement of actuaries within the process.

To facilitate this part of the paper, we have consulted with a range of managing agencies from across the market. Below, we firstly discuss data considerations and then comment on some of the approaches taken to providing for the main elements of the RITC premium – claims reserves (including outstanding and IBNR reserves), future premium reserves, claims handling expenses and reinsurance bad debts. Hindley et al [4] give further details of these and some of the other components of the RITC premium.

2.2 Data

The reporting deadlines established by Lloyd's will usually give insufficient time to conduct a full reserving exercise after the year-end. Hence most agencies will initially take a detailed look at the claims reserves underlying the RITC premium based on data effective as at 30 September prior to the year end. Some of the other elements, e.g. reinsurance bad debts and claims handling reserves, may be left until after the year-end.

The sub-division of data used to derive the claims reserves and future premium reserves can vary between agencies and also between syndicates. Some agencies will base their calculations on regulatory classes, others on internal management classes.

The treatment of currency within the calculations can also vary. Some agencies will use the three main reporting currencies (Sterling, US Dollars and Canadian Dollars), while others will use a Sterling equivalent basis and then work back to individual currencies later.

Another variation is in the treatment of reinsurance. Some agencies will work with gross and net data, and calculate reinsurance recoveries from the difference between gross and net projections. Others will evaluate the offset for reinsurance explicitly, calculating the net reserves as gross reserves less projected reinsurance recoveries.

2.3 Approach to Claims Reserves

Given that most agencies will have provisionally established the claims reserves underlying the RITC premium based on data as at 30 September, the transition to actual year-end data needs to be considered. If there are no significant differences between the actual and expected movements in claims payments and estimates during the final quarter, the 30 September reserves may just be rolled-forward to the year-end. If, however, there have been some significant movements or loss events, the reserves underlying the RITC premium may be adjusted.

Alternatively, rather than just rolling forward, it is possible that the reserves underlying the RITC premium may be recalculated based on the actual fourth quarter data.

The methods used to set the claims reserves underlying the RITC premium can vary. Statistical methods may be used or alternatively benchmarking techniques based on the development of similar business in the past. The judgement of the active underwriter will be of particular importance.

The role that actuaries have in the process of setting the RITC premium has steadily increased over time. The range of actuarial involvement can be summarised as follows:

- The actuary may liaise directly with the underwriter and may assist the underwriter in setting the RITC premium, with the final premium largely determined by the underwriter.

- The actuary may liaise with the underwriter and the underwriter may take the actuary's estimated claims reserves directly (usually after much discussion) in setting the RITC premium.

- The actuary's opinion as to the adequacy of the reserves established for solvency purposes may be something that the underwriter takes into account when setting the RITC. This is particularly relevant for syndicates with no in-house actuary. If the RITC premium was set in isolation then it could cause problems when comparisons are made.

It should be noted that the reserves underlying the RITC premium are usually identical to the reserves established for solvency purposes.

2.4 Approach to Future Premium Reserves

For the RITC premium of most syndicates, this tends to be a relatively small item. Any provision established will usually be based on an assessment of historic premium development.

If this element is positive then it is taken as a credit within the overall amount needed to meet the future liabilities. However it can be negative, for example, if policies with no claims bonuses have been written. This will, in effect, result in an addition to the claims reserves in order to meet future liabilities.

2.5 Approach to Claims Handling Expenses

The actuary may be involved in the original calculations of the claims handling provision. Alternatively, the actuary may just get involved in reviewing the provision established. The signing actuary for solvency purposes will also need to be satisfied that the total reserve, including the provision for claims handling expenses, is sufficient prior to signing the opinions. In considering claims handling expenses, the actuary is likely to have regard to the approaches discussed in Newman et al [8].

If the actuary is not involved originally then the finance staff of the agency will usually be responsible for the calculation.

Consideration will also need to be given to whether the calculations are on a going-concern or a winding-up basis.

2.6 Approach to Reinsurance Bad Debts

Again the actuary may be involved in the original calculations of the provision for reinsurance bad debts. Alternatively, the actuary may just get involved in reviewing the provision established. The signing actuary for solvency purposes will also need to be satisfied that the total reserve, including the provision for reinsurance bad debts, is sufficient prior to signing the opinions.

If the actuary is not involved originally then finance and reinsurance staff of the agency will usually be responsible for the calculation. The allocation of the reinsurance IBNR to individual reinsurance policies, and hence reinsurers, will be important in order to establish the bad debt provision. There are various methods of doing this and the method chosen could lead to some variability in the final provision.

There may be some differences in approach to the calculations depending on who is involved. The actuary is likely to have regard to the approach discussed in Bulmer et al [2] and may tend towards the pooled risk approach using default probabilities.

Agency staff may use a similar approach or something more general based on the active underwriter's judgement and knowledge of the reinsurers involved.

2.7 Review of the RITC Premium and Risk Margins

The final RITC premium, regardless of how it is calculated, will ultimately need to be ratified by the Board of Directors and the auditors of the managing agency. The Board will usually rely heavily on the active underwriter in this respect.

Any allowances for risk margins can be explicit but the evidence we have suggests that, in general, any margins are usually incorporated in the process implicitly. The margins tend to be based on the commercial judgement of the active underwriter.

3. IMPLICATIONS OF A TWO-SIDED ACTUARIAL OPINION

3.1 Introduction

It appears at present that Lloyd's has no intention of requiring a two-sided statutory opinion on syndicate reserves or the RITC. However it does seem to be looking to encourage more actuarial involvement in the RITC process, in which equity between names on the closing year of account and names on the accepting year of account is the main requirement and any advice given would be of a two-sided nature.

Although a two sided regulatory opinion does not seem to be likely in the near future, it is worth considering the implications of its introduction should circumstances change. A full consideration of the implications could be very lengthy, and we do not suggest that the following discussion covers every ramification. What we have chosen to do is to concentrate on the implications from the perspective of the key stakeholders in the outcome of the RITC.

Hindley et al [4] list eighteen ostensible stakeholders in the reinsurance to close process. However, there are only five where it could be argued that their interest in the process is worthy of regulatory protection: policyholders, Names, shareholders, the Corporation of Lloyd's, and the Inland Revenue. We consider each of these in turn.

3.2 Policyholders

A policyholder's over-riding requirement from insurance/reinsurance is that the accepting syndicate is able to fulfil its contractual obligations. Presumably the risk against which they have insured is potentially financially material - otherwise, why insure? - so they need to be confident that payments due to them will be made on time and in full.

This requirement is best served by the existing one-sided solvency opinion. In fact, unreasonably high reserves are a major advantage from the policyholder's perspective, since they reduce the probability of a contractual breach compared to the holding of "reasonable" reserves. Hindley et al [4] may run the risk of underplaying this issue in their claim that there might be a "slight increase in risk" that a syndicate could not meet its obligations.

The policyholder also has an interest in the level of premium he has to pay. Hindley et al [4] see an advantage from two-sided opinions accruing to the policyholder in this regard but only if the two-sided opinions applied to insurers worldwide. This argument may be spurious. First, any "reasonableness" opinions would clearly not have worldwide application in the foreseeable future. Secondly, even if they did, they may be more likely to increase premiums than to reduce them. Insurers that had

previously used reserve margins to reduce the volatility of their returns would, with this option reduced or removed, seek to compensate through increased margins in premiums.

Note that the policyholders' interest in reserve levels is not a Lloyd's-specific issue. Policyholders in non-Lloyd's insurers have an equivalent stake in the reserves held by those insurers. If Lloyd's were to introduce a regulatory requirement for two-sided opinions and policyholders perceived this as detrimental to their interests, then Lloyd's insurers would be placed at a competitive disadvantage to the rest of the UK and much of the worldwide market where two sided solvency opinions are not in place.

3.3 Names

Names divide into two groups – aligned (for example corporate capital members with an interest in the managing agency) and non-aligned. The interests of the former group are equivalent to those of shareholders, which are discussed later. The interests of non-aligned Names are quite distinct, however.

The RITC calculation is the main determinant of the level of profit or loss that each generation of Names receives from their investment in the annual venture. The Board of the Managing Agent is required to set the RITC premium at a level that is fair and equitable to both sets of Names. If the RITC premium is set too low, the accepting Names suffer unfairly; if it is set too high, then the ceding Names suffer.

Where there is a mixture of aligned and non-aligned capital, however, the Board has a conflict of interest. Their agency obligations require them to treat both sets of Names equally but, at the same time, their employer benefits from the performance of the aligned capital, perhaps with direct implications for their own remuneration.

This potential conflict of interest is not a real issue if the ceding and accepting populations of Names have broadly the same compositions. It becomes significant, however, where there is a large difference in the aligned/non-aligned mix between the two generations of Names. This has been the case for the last few years, where most mixed capital syndicates have experienced successive year-on-year shifts towards aligned capital.

Thus, there has been, and will be for the next few years, an opportunity for the unscrupulous managing agent, or the managing agent under severe pressure from its aligned capital, to overstate RITCs to the detriment of non-aligned capital. The scale of this potential problem is undoubtedly mitigated by the fact that most of the key transitional years will be loss making for many syndicates. Nonetheless, there is a clear need to protect the interests of the non-aligned capital.

This protection already exists in two forms. Firstly, the syndicate auditors are required to ensure that the transaction between the different generations of Names is true and fair. Secondly, Lloyd's centrally is responsible for ensuring that the managing agencies fulfil their agency obligations.

A two-sided statutory opinion would add a further layer of protection, in that the reasonableness ceiling would help ensure that the RITC was not set at a level to penalise the ceding Names. Whether it is an appropriate way of dealing with the problem is debatable, however. Certainly, for syndicates where capital is 100% aligned, there are no Names in need of this protection. In a few years time, it is likely that a substantial majority of syndicates will be backed by aligned capital only. The window of opportunity where a two-sided opinion might be relevant protection for Names is narrow and is already shutting. This is demonstrated in the following table, that shows the mix of individual and corporate capacity at Lloyd's since 1993. The shaded years have already closed.

Capital Source	1998	1999	2000
Names	45%	34%	33%
Spread Corporate	25%	20%	67%
Aligned Corporate	30%	46%	
Total Capacity (£m)	10,169	9,870	10,045

Stock Market takeovers of the quoted spread vehicles by managing agencies and ensuing moves to align their portfolios mean that aligned corporate capacity must have grown significantly at the expense of spread corporate capacity for the 2000 year of account.

Given all the above, a regulatory requirement for a two-sided actuarial opinion seems a very blunt instrument, especially when it is to protect against a problem that may not even exist. It also only provides a prospective solution, when the issue is also relevant to the closures of the 1997 and prior years of account. Perhaps it would be better for Lloyd's centrally to look at those years to see if there is any evidence of a problem and so whether a "solution" actually needs to be imposed on the market at all.

3.4 Shareholders (Owners)

The impact of an over-stated RITC on shareholders is that the emergence of underwriting profit is deferred, tax is deferred, and investment income is increased. The true profitability of the syndicate may be obscured, but profits will generally be less volatile over time. Whether this is a good or a bad thing depends on the perspective of each shareholder.

The shareholders are the owners of the managing agency and appoint its management (directly or indirectly). A major part of the auditors' role is to protect shareholders from fraud or incompetence on the part of those managing the business. It is hard to see a regulatory requirement for two-sided opinions being of any benefit for 100% or majority shareholders. It would simply constrain the freedom of the appointed managers to run the business in the way in which the shareholders intend.

Two-sided opinions could, however, offer some protection to minority shareholders. It is possible to imagine a situation where an unscrupulous majority shareholder might wish to deliberately overstate reserves/understate profits in order to effect a takeover on advantageous terms. This is not a Lloyd's-specific issue, however. It affects the entire insurance industry and the debate needs to take place in that context. It is not reasonable to place Lloyd's syndicates at a competitive disadvantage by requiring a two-sided opinion to protect minority shareholders when no such constraint applies to insurance companies, where minority shareholders are exposed to the same risks.

3.5 Corporation of Lloyd's

The interest of the Corporation of Lloyd's in the level of RITC set by managing agencies, aside from its regulatory responsibilities, revolves around the potential impact of those reserving decisions on the Central Fund and on the future of the Lloyd's market. Here, a two-sided opinion is probably detrimental to those interests.

The higher a syndicate's own reserves, the lower the risk of that syndicate threatening the Lloyd's chain of security. Depending on the extent to which "unreasonably" high reserves are set at present, two-sided opinions could reduce the security of the Central Fund and, hence, threaten Lloyd's credit rating. In order for the Central Fund to maintain its' level of security and rating, Lloyd's would need to raise the level of capital required from Names to support the business being underwritten. Depending on the scale of increase, this might reduce the availability of capital in the Lloyd's market and so the volume of business that can be transacted. If the capital lost does not move to other insurance markets this might lead to improved rates and profitability. However if, capital does leave in favour of other insurance markets, then the size and performance of the Lloyd's market will suffer in comparison.

Having said that, a two sided opinion on RITC (and open years solvency reserves) would allow Lloyd's to better assess the relative and absolute levels of risk associated with the various types of business than they are currently able to with one sided opinions. This could reduce the degree of risk they have to date assessed as being present and so reduce the overall capital requirement for the market. Again the extent of any reduction would depend on the extent to which reserves have to date been "unreasonably" high.

The interaction between the two effects is complex. As Lloyd's sets its' capital requirements to achieve a particular (low) probability of ruin, and so is concerned with the extremes of possible outcomes, it would appear that two sided opinions would reduce the capital requirement due to better assessment of risk by less than they would increase the requirement due to reducing the total reserves held at syndicate level. Hence the overall effect would seem likely to be a reduction in security leading to an increase in the capital required from Names through the Lloyd's RBC process.

3.6 The Inland Revenue

For most taxpayers, where cashflows in and out are usually known in terms of amount and timing, the calculation of the amount of tax they owe is a fairly objective, mechanical process. For insurers, where cash outflows in respect of claims are uncertain (perhaps extremely so) the process is far more subjective. There is, hence, far more scope for disagreement between the concerned two parties.

The Inland Revenue is currently in dispute with many syndicates, claiming that they are over-reserved (or were over reserved at they time they closed certain years of account) and, hence, not paying enough tax. Against this background, the benefit of a two-sided opinion for the Revenue is very clear. Again, however, it is important to remember that the issues for a Lloyd's syndicate are equivalent to those for an insurance company. Requiring Lloyd's syndicates to get a two-sided opinion for the Revenue would place them at a disadvantage against their non-Lloyd's competitors who are not subject to such an environment. Following the changes announced in the last Budget, the debate over this is now taking place in a UK market, not just a Lloyd's, context.

3.7 Conclusion

Of the five stakeholders discussed, two-sided opinions are likely to be detrimental to the interests of at least two of them – policyholders and the Corporation of Lloyd's. Of the remainder, the interests of shareholders and of the Inland Revenue apply across the whole insurance market, not just to the Lloyd's market. It would therefore be unreasonable and unfair to impose restrictions solely on Lloyd's syndicates to protect the interests of those stakeholders.

That leaves only the Names. Aligned capital is continuous capital under the same control as the managing agent setting the RITC. It gets no benefit from further regulatory involvement in the closure process, which will only serve to restrict its management's freedom and to increase its costs.

The issue, thus, comes down to protecting the interests of non-aligned capital during the period of transition in the capital base of Lloyd's. This would seem to be the only justification for moving to a two-sided RITC reserve opinion. Whether it is the best way of dealing of this matter is, however, highly questionable for the following reasons.

- Protecting non-aligned capital in this way harms the interests of policyholders, the Corporation of Lloyd's and, debatably, shareholders. If it were to adversely affect the Lloyd's rating, it would undoubtedly harm shareholders and Names themselves (aligned and non-aligned).

- It imposes an unnecessary regulatory expense and management constraint on syndicates where there are no non-aligned interests to protect.

- It imposes a further competitive disadvantage on Lloyd's syndicates compared with their non-Lloyd's competitors.

- It is a prospective approach to an issue of relevance to the already closed 1993 to 1997 years of account.

- It provides a "solution" to a "problem", when there is no evidence to show that the "problem" even exists.

4. RESERVING EXERCISE

4.1 Objective

Currently, calculations supporting actuarial opinions on Lloyd's syndicates are done on a best estimate basis, and the opinions support the adequacy of the reserves.

The actuary's "best estimate" is generally a point estimate. This point estimate depends on the methods and assumptions used by the actuary. In practice, there is typically a range of reserve levels around the point estimate, where the actuary could, with relatively minor changes to methods and/or assumptions, produce different reserve estimates that he would be happy to sign off as "best estimate". In other words, there is a "grey area" around any individual actuary's best point estimate where he would consider any alternative reserve value to be a reasonable best estimate.

Where a managing agency proposes reserves in excess of the actuary's best point estimate, the actuary can provide an opinion without any thought to the "grey area". If the agency proposes reserves below the point estimate, however, then the actuary needs to address the issue of how low he can go with his best estimate, that is, he needs to define the floor to his "grey area".

Hindley et al [4] argue in favour of extending the actuarial opinion from one of adequacy to one of reasonableness. In those circumstances, the actuary would be signing off that the reserves were both adequate and not unreasonably high. Following an initial point estimate, there would always be a requirement for the actuary to consider one extreme of his "grey area". If the syndicate's proposed reserves were lower, he would have to consider its floor; if higher, its ceiling.

The Working Party sought to explore a number of issues arising from the above. Specifically:

- How do best point estimates of different actuaries compare?
- How wide is the "grey area" within which an individual actuary would consider a reserve to be a reasonable best estimate?
- How do the floor and ceilings of the "grey areas" of different actuaries compare?

4.2 Method

In order to investigate these issues, the Working Party devised a reserving exercise whereby different actuaries would be asked to specify best estimate reserves, lowest adequate reserves, and highest reasonable reserves, from the same sets of data.

Triangles of incurred claims were compiled for two pseudo-syndicates, Syndicate A specialising in short-tail property business and Syndicate B which specialised in long-tail liability business. Various simplifying assumptions were made in order to decrease the work involved and, hence, increase the response rate.

The information that was provided is shown in Appendix B.

The exercise was mailed out to all general insurance actuaries and students in the UK. Forty-two responses were received, fifteen of them from actuaries with Practising Certificates enabling them to sign Lloyd's opinions.

4.3 Limitations

The ability of this exercise to achieve our objectives is obviously limited by its lack of reality. The following considerations are particularly relevant:

- Only limited information was provided on each syndicate and nothing further was available. Additional information, and the opportunity to discuss it and explore any issues with the relevant underwriters would, most likely, have narrowed the range of each actuary's "grey area" and reduced the variation between the estimates of different actuaries.

- In a move carefully aimed at the target population, responses were encouraged by the prospect of an alcoholic prize. This provided an incentive for returning the questionnaire, but not for ensuring that the analysis made best use of the data provided. In signing an opinion, actuaries are putting their qualification on the line. It is likely that the extra focus this would encourage would, again, serve to narrow the range of each actuary's "grey area" and reduce the variation between the estimates of different actuaries.

These limitations should be borne in mind when considering the analysis and conclusions below.

4.4 Analysis

The results of the reserving exercise are discussed below.

Variability of Best Estimates

The tables below set out the variability of best estimates for each separate economic entity. Results are shown both for the whole population of respondents and for that subset of the population holding Practising Certificates. All figures are stated relative to the median estimate for the whole population.

Best Estimate Reserves - Syndicate A (Short Tail)					
Year of Account	**Group**	**10th percentile**	**Median**	**90th Percentile**	**Range: 10th – 90th**
1997 & Prior	**Population**	0.75	1.00	1.37	0.62
	Certificate Holders	0.81	0.99	1.39	0.58
1998	**Population**	0.90	1.00	1.08	0.18
	Certificate Holders	0.90	1.01	1.06	0.16
1999	**Population**	0.83	1.00	1.18	0.35
	Certificate Holders	0.82	0.91	1.17	0.35

Best Estimate Reserves - Syndicate B (Long Tail)					
Year of Account	**Group**	**10th percentile**	**Median**	**90th Percentile**	**Range: 10th – 90th**
1997 & Prior	**Population**	0.90	1.00	1.09	0.19
	Certificate Holders	0.95	1.02	1.08	0.13
1998	**Population**	0.88	1.00	1.13	0.25
	Certificate Holders	0.94	1.01	1.19	0.25
1999	**Population**	0.88	1.00	1.15	0.27
	Certificate Holders	0.92	1.04	1.18	0.26

In all cases, it is clear that there is significant variation in the best estimate reserves for each economic entity, as calculated by different actuaries. The largest variation, as a proportion of the median reserve estimate, occurs on Syndicate A for years 1997 and

prior. This is also the least material variation, as reserves for this entity are much lower than for any other.

Range of Best Estimates

The tables below show the average range of acceptable best estimates for each individual actuary. Figures are expressed as proportions of each actuary's point best estimate reserves, and then averaged.

Range of Acceptable Best Estimate Reserves – Syndicate A (Short Tail)				
Year of Account	**Group**	**Lowest Adequate**	**Highest Reasonable**	**Range**
1997 & Prior	**Population**	-0.37	0.45	0.82
	Certificate Holders	-0.28	0.38	0.66
1998	**Population**	-0.07	0.12	0.19
	Certificate Holders	-0.07	0.14	0.21
1999	**Population**	-0.13	0.23	0.36
	Certificate Holders	-0.12	0.25	0.37

Range of Acceptable Best Estimate Reserves – Syndicate B (Long Tail)				
Year of Account	**Group**	**Lowest Adequate**	**Highest Reasonable**	**Range**
1997 & Prior	**Population**	-0.08	0.11	0.19
	Certificate Holders	-0.08	0.12	0.20
1998	**Population**	-0.09	0.15	0.24
	Certificate Holders	-0.10	0.16	0.26
1999	**Population**	-0.15	0.25	0.40
	Certificate Holders	-0.15	0.23	0.38

In all cases, the average results indicate that the "grey area" is skew about the point estimate, with more scope for upwards movement than for downwards. This is not surprising, given the skewed distribution of the underlying reserves.

The main point that emerges, however, is that the range of acceptable best estimates is always material. Its lowest level is 19% of the point estimate, its highest is 82%.

Variability of Floors and Ceilings

The graphs in Appendix C show the median, 10th percentile and 90th percentile reserve estimates for each of the six economic entities (two syndicates x three open years of account). Results for the whole population and for actuaries with Practising Certificates only are shown.

In all cases, there is significant variation between the 10th and 90th percentiles of the distribution of lowest, best estimate and highest reserve estimates.

More significantly, when the whole population of respondents is considered, for all six economic entities, the 90th percentile of the distribution of lowest "best estimates" is higher than the 10th percentile of the distribution of highest "best estimates". The implication of this is that, for all six entities, there is a range of reserves that more than 10% of respondents consider to be inadequate but that a different 10% plus of respondents consider unreasonably high. In some cases this range is very wide, for example, for Syndicate B, 1998, it covers £80.1m to £90.3m.

Even focussing on the "expert" subset of the population holding Practising Certificates does not change the results dramatically. In that case, five of the six entities have a 90th percentile lowest "best estimate" higher than the equivalent 10th percentile highest "best estimate". The only exception is Syndicate B, 1997 and prior, where they are almost equal.

4.5 Conclusions

The main conclusions that can be drawn from this exercise are as follows:

- Different actuaries working from the same information may come up with significantly different point value best estimate reserves.

- Each actuary will tend to accept a fairly wide band of reserve levels around their point value best estimate as reasonable alternative best estimates. The size of this band may be very material compared to the level of reserves.

- Despite the wide bands most actuaries accept as reasonable, some actuaries may come up with a band of acceptable best estimates that has no overlap with the equivalent ranges of other actuaries.

These conclusions stand whether one considers the whole actuarial population or simply the "expert" proportion that holds Practising Certificates.

Clearly, the conclusions drawn from this analysis have potentially significant implications for the existing role of actuaries in signing opinions as to the adequacy of

syndicate reserves, let alone when considering extending that role to a two-sided "reasonableness" opinion or to all-embracing reporting on financial condition.

Whilst it would be premature to assume that these same conclusions could be drawn from a more realistic investigation, the Working Party believes that the Profession should take steps to get a better understanding of these implications. A good first step would be to repeat this exercise using much more complete data and a group of "experts" who are thoroughly briefed on the importance of conducting a full and thorough analysis. This approach would circumvent the principal limitations of this initial investigation.

5. METHODS OF MEASURING THE VARIABILITY IN RESERVES

5.1 Introduction

One problem with traditional reserving methods is that they provide little by way of objective material for determining the degree or quantum of variability in the reserves. Existing approaches, by and large, determine point estimates. In general, actuaries have devoted relatively little time to the development of methods that measure the variability in reserves.

We have considered a number of different approaches to measuring the variability in reserve estimates. These methods have all been discussed in the actuarial literature. We have used each method to measure the inherent variation in our estimates for the two hypothetical syndicates from our reserving questionnaire. Using each method, we have calculated the standard deviation of the reserve estimates for each syndicate and for each of the following year groups:

- 1993 to 1997 years of account
- 1998 year of account
- 1999 year of account
- 1993 to 1999 years of account

It will be noted that the first three year groups listed above correspond to the closing year and the two open years that actuaries were required to sign-off on as at 31 December 1999 as part of the solvency opinions. The final grouping is the total of all of the years of account that they considered and is also the group of years that an actuary working in the company market would have needed to consider at that date.

In order to produce results that were comparable across the various methods, we first selected appropriate reporting patterns, payment patterns and best estimate reserves for our two hypothetical syndicates. Our selections and calculations are shown in Appendix D. In presenting these results, we are not intending to imply that our selections and estimates are in any way more appropriate or more robust than any of the selections made by respondents to the reserving questionnaire. We are simply presenting them on the basis that they give estimates that are not unreasonable, and that they provided us with a consistent basis from which to derive our various measures of variability.

Appendix F shows the standard deviations derived from the various methods considered. It will be seen that there is little consistency - the standard deviations vary significantly between the different approaches.

The different methods we have considered for measuring variability are in no way intended to be an exhaustive list. They merely represent some examples of approaches that can be utilised relatively easily for RITC purposes. It is possible to use all of these methods without a detailed understanding of the statistical theory on which they are based. In our view, this is an important consideration since not all actuaries working in this area would claim to be expert statisticians.

In the following sections, we discuss, in turn, each of the methods considered. We have provided a brief overview of each approach, together with comments on their applicability in these circumstances. We have not gone into the details of each method since these are covered elsewhere in the actuarial literature. Readers interested in particular methods are advised to refer to the original papers, which are listed in Appendix A.

5.2 Bootstrapping – Standard Approach

This method is described in Lowe [6].

In this case, the incurred data triangle was used and 1000 simulations were performed with a fixed tail factor of 1.15 for Syndicate B

Description of the Method

(a) The incremental payments are calculated from the cumulative incurred data triangle.

(b) The volume weighted chain ladder factors are calculated from the cumulative incurred triangle.

(c) A 'fitted' triangle is calculated using these factors, working back from the current diagonal.

(d) The 'fitted' incremental payments are calculated.

(e) Pearson residuals are calculated as:
(observed incrementals – fitted incrementals) / square root of the fitted incrementals.

(f) The residuals are randomly reallocated to different positions in the triangle with replacement.

(g) The incremental payments are bootstrapped such that the bootstrapped incremental payment = fitted incremental + (Pearson residual * square root of fitted incremental).

(h) The triangle of bootstrapped cumulative payments is calculated, and volume weighted chain ladder factors are derived from this.

(i) These factors, along with a tail factor are used to project the cumulative bootstrapped position forward.

Observations on Using the Method

- This method produced standard deviations that were similar to the results produced by the other methods for Syndicate A, with the exception of the closed years (1993-1997). Here the variation was much higher due to the use of residuals from early in the development triangle, which seem unlikely in practice given the nature of the underlying business.

- Across all the years, the standard deviations produced for Syndicate B were lower than for many of the other methods.

- This method is relatively easy to model on a spreadsheet. Ease of use is likely to be a big plus for a method that is to be used widely.

- It has the advantage that little data is needed, particularly for short tail classes.

- One problem with this method is that it does not readily apply to results from methods other than the chain ladder.

- Assumptions need to be made about how to deal with a tail factor. The assessment of this is very subjective.

- The residuals arising early in the development triangle may be large. It may not be appropriate to apply these to the tail of a triangle where variability should be lower, as this could introduce unacceptably high levels of variability.

- The model assumes that there is an underlying distribution to the run off data. The actual data will vary randomly from this. The mean will arise from the underlying distribution whilst the standard deviation measures the variability from that distribution.

- This method can produce highly variable results even for relatively stable data.

5.3 Bootstrapping – Reduced Variability Approach

Much of the variation from using a bootstrapping method comes from two sources:-

- The largest standardised residuals tend to arise early in the development of the data. This reduced variability approach ignores the residuals produced in the earliest development period on the grounds that we are interested in the tail end of the distribution.

- Standard bootstrapping techniques use future factors derived from the re-sampled data. In practice when setting reserves actuarial judgement is used, and this reduced variability approach reflects this by applying the past variation in the data to the selected run off pattern.

Description of the Method

The assumptions as to tail factors, derivation of the reserves, and the number of simulations were as for the standard bootstrapping approach.

The procedure followed is as follows:

(a) The incremental payments are calculated from the data.

(b) A triangle of fitted cumulative data is calculated from the current diagonal and the selected input factors, working backwards.

(c) The fitted incremental amounts are calculated.

(d) The Pearson residuals are calculated as:
(fitted incremental - observed incremental) / square root of the fitted incremental.

(e) The Pearson residuals are randomly reallocated to future development periods with replacement.

(f) The bootstrapped incremental payments are calculated as follows:
Z = cumulative paid to date * (selected factor-1)
Bootstrapped Incremental Payment = Z + random residual * square root of Z.

Observations on Using the Method

- This is easy to model in a spreadsheet. A degree of subjectivity is introduced in the selection of a set of future development factors, but this mirrors the reserving process.

- It produces much lower standard deviations for Syndicate B than the other methods due to the fairly uniform development of the incurred data for all the years; in particular, the standard deviation of the most recent underwriting year appears to be very low. The results for all years are considerably below those produced by the standard bootstrapping approach.

- For all combinations of years considered, the standard deviations for Syndicate A are much closer to those produced by the other methods, due to the more variable nature of the run-off triangle. They are still lower than the standard bootstrapping approach, particularly for the oldest years, where the use of residuals from early in the development causes very large variations.

- This method uses the current incurred diagonal rather than re-sampling the actual data.

- It removes the most variable factors that will not really apply to the tail of a development triangle.

- It uses actuarially selected factors which are based on actual experience, and then applies variation to these. This more closely mirrors the reserving process whilst still giving weight to actuarial judgement.

- This approach assumes there is no underlying run off pattern. The pattern selected will vary from the data and this is assumed to continue in the future.

- This approach assumes that the data can be adequately modelled using the chain ladder approach to reserving.

- It may remove too much of the underlying variation from the future development.

- Assumptions are needed for modelling the tail of the business, which will be subjective and, with the volume of data in our example, hard to assess.

5.4 Mack

Description of the Method

- This method quantifies the variability of the chain ladder reserve estimates without assuming any specific underlying claims distribution function.

- The variability is calculated by establishing a formula for the standard error, which is an estimate for the standard deviation of the outstanding claims reserve.

- The necessary information is extracted only from the usual chain ladder formulae and data.

- With the standard error as a tool a confidence interval for the outstanding claims reserve and for the ultimate claims amount is constructed.

- The method is described in more detail in Mack [7].

Observations on Using the Method

- This is a reasonably simple method to understand and implement.

- The method relies on the basic chain ladder being an appropriate projection method for calculating the ultimate claim amount.

- The method has the advantage of not involving any subjectivity in its application which should lead to consistency in results derived by different parties.

- A major disadvantage of the method was that it gave rise to what we considered unreasonably large ranges in the more recent years due to the lack of data in these years. This led us to subjectively choose narrower ranges that we considered more reasonable for these years of account.

- Another area of subjectivity is the choice for a range on the development beyond the data triangles.

- However, the basis of the subjective decisions above can be clearly stated and the chosen range can be compared with the pure theoretical result and hence need not lead to a misleading result or a misleading impression of the potential variability in the reserves.

5.5 Patel and Raws

Description of the Method

- The approach has its origins in US practice for statutory reserving.

- It assumes that the actuary has used a variety of reserving methods to give a number of different point estimates of the ultimate liabilities for each year.

- The range of point estimates for a given year can be used to define a distribution of possible outcomes for the year.

- The choice of distribution is a matter of judgement.

- The actuary may wish to use different distributions for years of different degrees of maturity or uncertainty.

- The derivation of the distribution parameters is also a matter of judgement. For instance, the mean of the distribution might be the average of the various point estimates and the standard deviation may be related to the difference between the highest and lowest point estimates.

- The chosen distribution and parameters for each year can be used to stochastically simulate possible outcomes, determine the variability of the total liabilities and hence of the total reserves.

- The method is described in full in Patel and Raws [9].

Observations on Using the Method

- The method involves the use of a large number of subjective decisions which makes it susceptible to abuse.

- The range of point estimates for a year are unlikely to cover the full range of possible outcomes.

- Deciding how much of the actual range of possible outcomes they do cover is a highly subjective decision and the final outcome is unlikely to be statistically robust.

- In many instances, the estimate of ultimate liabilities the actuary has selected may be the highest or lowest of the point estimates for the year. In this situation, the actuary is faced with either

  - Centering the distribution on their selected ultimate, using, say, the largest difference between that and the other point estimates to define the variability and assuming that the distribution is symmetrical. In effect, the actuary is creating extra point estimates outside their original range.

  - Centering the distribution on the average of the point estimates, using the difference between the highest and lowest point estimates to define the variability and assuming that any resulting standard deviation applies equally around the actual selected ultimate.

- The method is somewhat self-fulfilling, in that there is a tendency to derive the standard deviation of distributions from the point estimates (e.g. the maximum to

minimum difference equalling four standard deviations). The simulated variability for that year is not exactly going to be a surprise.

- The choice of distribution parameters is limited wholly or partially by the point estimates and probably does not encompass the full range of outcomes so the overall variability derived will tend to be lower than that produced by many of the other methods. This may be practically useful, as it avoids many of the presentational and decisional problems of large variability, but risks giving a false message regarding the certainty of outcome.

5.6 Sanders and Leifer

Background

This method is discussed in detail in Sanders and Leifer [11]. The reasons for using the method are documented in that paper.

In summary, the use of the Mack method to estimate the standard deviation ignores the distribution of the underlying link ratios. The process of estimating the tail and making judgements within the process of selecting an ultimate loss also tends to reduce the Mack standard deviation.

The paper explores the reduction in the standard deviations compared to the Mack method. A number of methods are outlined by the authors but we have selected just one and it is described below.

Description of the Method

(a) Taking the cumulative triangle of incurred claims, the link ratios are calculated. For each development period, appropriate overall link ratios are selected, as is an appropriate tail factor.

(b) Next, the standard deviation of the link ratios for each development year is calculated. For later development periods, there are fewer link ratios on which to base the standard deviation. Hence, in this case, a broader view has been taken. We have calculated the standard deviation for the last development year where there are sufficient data points and then used this for all subsequent development years, including the tail factor.

(c) Having selected a mean and standard deviation for the link ratio at each development period, we then had to make an assumption regarding their distribution. For this paper, as in the original paper, we have assumed a normal distribution with the selected mean and standard deviation as the parameters.

(d) For each syndicate, a large number of simulations of the ultimate losses and reserves for each underwriting year were run. The standard deviation across all of the simulations was then calculated.

5.7 Zehnwirth

Background

The full background to this method can be found in various papers, perhaps the best of which is Barnett and Zehnwirth [1]. A further reference that explains the details of the modelling framework is Zehnwirth [14].

Description of the Method

The method works on incremental claims data as opposed to the cumulative incurred or paid claim data used in many other methods. The aim is to identify a parsimonious model that separates out the systematic trends in the incremental paid claim data from the random fluctuations. The step-by-step approach applied as follows:

(a) A triangulation of incremental paid claim data is used as input along with a measure of relative exposure for the class of business between underwriting years. The data is transformed (effectively by taking the logarithm) to manage the effect of the "skew" nature of insurance claims and is scaled to a common level using the exposure measure as a "normalising" parameter.

(b) Standardised data is investigated for trends in three "directions" using an iterative process. The three directions are the development year direction, payment year direction and the underwriting year direction. The model starts off with one parameter (trend) in each direction. The iterative approach then models (sequentially) the trends in the development year direction, followed by the payment year or underwriting year direction, depending on which exhibits the most dramatic trend changes. In addition to deriving the mean value of trends in each direction, the process also derives the standard deviations about these means.

(c) The model derived fits the data statistically i.e. a simulation from the model would look similar to the underlying data. In reality, a number of statistical models are possible. The "best" model is selected using a number of test statistics and by testing the model for expected predictions for more recent years against the actual outcome. The model is defined in terms of the trends set out in (b) above. Along with the exposure measure, the expected value and standard deviation of any "cell" in a projection can then be derived. An appropriate model is derived when assumptions (i.e. trends) are borne out by the data, and data is of sufficient quality.

(d) The missing part of the triangle is then forecast using the statistical model and by assuming the derived trends continue into the future. In some cases, it is necessary to forecast beyond the last development period in the base data when it is evident that the run off pattern for the class of business is longer than the extent of the data.

Observations on Using the Method

9 The forecast distributions from this method are accurate provided the assumptions made about the future remain valid.

- The best model produces a low result for the most recent year in the short tailed syndicate. In practice, subjective information would be considered and the reserve chosen would take this into account. Little by way of subjective information was available in this instance and the mean outcome was taken as the selection.

- It is likely that the results of individual years are correlated with other individual years in each syndicate. Because of the lack of detailed information, these correlations have been ignored in the analysis.

6. DERIVATION OF RISK LOADS

The derivation of a risk load to add to the RITC premium is a highly subjective and complex process. Ways have to be found to apply the theoretical methods in practice, so approximations and broad brush values are needed.

The first decision that is needed is what uncertainty should be loaded for when deriving a risk loading. Should the loading applied to the RITC premium cover merely the uncertainty inherent in a point estimate of the amount needed to meet future claims, or should other, harder to assess, risks be covered? In practice RITC premiums do not allow for discounting future claims payments – the margin provided by future investment income is assumed to cover the uncertainty of the ultimate claims cost and of the other elements of the RITC premium. If the suggested approach of taking a best estimate and loading explicitly for risks is followed then discounted estimates should probably be used.

A number of practical issues need to be considered when assessing the RITC premium and the associated risk loading. In general, the more data we have and the less volatile the claims experience, the lower the risk load. A number of issues connected purely with the claims data need to be considered:

- What variability are we certifying and what risks affecting the eventual outcome should be covered by this certification?

- How is the standard deviation of the reserve estimates calculated? There are a whole variety of methods which make different assumptions and can produce very different results as can be seen from our use of different methods.

- To what extent is the historic data affected by such things as catastrophes that are, by definition, uncommon events, and should a loading for these be included?

- How good is our knowledge of the underlying data?

- Have there been changes in reporting or settlement procedures over the period being considered?

- On what basis are outstanding claims reserves set (worst case, most likely, etc)? Has this changed over the years? How close to the upper limits of the policy are claims subject to more than the usual uncertainty?

- How should changes in the outside environment e.g. court awards or legal changes be handled, and to what extent are these already reflected in the data?

- How many years data are needed, and how is the modelling approached for new classes of business?

- How is the run-off tail of the business modelled?

When setting the total risk loading there are a number of practical issues that need to be considered:

- Should the risk margin cover only the reserving variability in the claims data, or should it also cover other factors? How can these be assessed? Broad brush measures for some risks are fairly obvious e.g. reinsurance bad debt can be based on the amount expected to be recovered from reinsurers, split by the security rating of the reinsurer (see [2]). Factors that could be covered include:

  - Reinsurance bad debt

  - Asset liability risk i.e. mismatching

  - Court awards / claims inflation

  - Catastrophes

  - Lack of management control etc

  - Unexpected claims e.g. asbestos, pollution and other latent liabilities

  - Uncertainty over future payment patterns

  - Adequacy of the loading for claims handling expenses

  - How near to exhaustion the reinsurance protection is

- The variability and hence risk load are reduced by diversification. In considering the extent of diversification, it is necessary to have regard to the following:

  - Is a separate figure calculated for each open year and one for all closed years, or is an overall figure used, or is each year considered separately?

  - Is one figure calculated for each class, or for all business in total?

- A view will have to be taken in cases that involve court action. The eventual outcome may be very different to the amount reserved particularly if excess layers and/or punitive damages are involved. The presence of cases like this may require an additional risk loading.

- Should the reserve cover expenses and the risk that any reserve for these is inadequate?

- Who is taking the risk on? An individual Name at Lloyd's may have a very different requirement in terms of a risk loading to the degree of prudence a shareholder in a company with limited liability would require.

- Will the variability in the data provide sufficient variation for the more volatile liability classes, or should different numbers of standard deviations be used dependent on the class of business?

- Should a loading be specified by class of business to remove the chance that actuaries will use different loadings for the same business? If this is not done then there may be confusion with different practitioners making different provisions, which could cause credibility problems for the profession.

- What position in the underwriting cycle is the syndicate? The RITC process is often used to transfer surplus between underwriting years, building up a reserve that can be released when times are less prosperous, or to help cover very large claims. Although certification would help restrict this process, it would still leave room for syndicates to substantially alter the results when closing a particular underwriting year. The degree of over provision or release of built up surplus would depend on the stage of the underwriting cycle the syndicate was at, and the results of the preceding underwriting years.

- Are the reserves going to be discounted? This would remove an implicit margin, and so a higher level of provision may be needed

- Should the risk margin be allowed to exceed the discount used (if reserves are to be discounted)? This is particularly likely to be an issue when interest rates are low.

- To whom is the RITC premium being paid? It could be a transfer to the last open year of the same syndicate, between syndicates run by the same managing agent, or between unrelated syndicates. This will influence the size of the risk load required by the accepting syndicate.

- It is not always possible to close a year with an RITC premium if the uncertainty is too large. Given the state of the market this situation may become more common. This is due to:

  - The complex, diverse and often very long tail risks being written.

- The fact that the market works on a subscription basis so information is often not fully available.

- The reliance on large scale complicated reinsurance programs.

This situation will only worsen due to the increasing levels of litigation being experienced, which will, in turn, make assessment of outstanding claims reserves hard, particularly for layered risks where punitive damages may be involved. All these factors may make the assessment of a risk load on the RITC premium too complex and variable. It may thus be possible to set a maximum risk load in terms of the reserve and associated measure of variability, above which the result is considered too variable to close the year.

7. OFFSET BETWEEN RISK LOADS AND THE EFFECT OF DISCOUNTING

It is often the case that, when a managing agent sets the RITC premium for a syndicate, no explicit risk margin is included. At the same time, the RITC premium is often based on undiscounted reserves. The implicit assumption is that the future investment income provides an appropriate margin to allow for risk. It is clearly possible that the margin allowed for could either be too low or too high. A theoretically better approach would be to set the RITC premium based on discounted reserves, with an explicit risk margin to allow for the inherent uncertainty. The question then arises as to the extent to which such an approach would tend to increase or decrease the level of RITC premiums. This is analogous to asking the extent to which using undiscounted reserves makes an appropriate allowance for risk.

To investigate this, we have used our two hypothetical syndicates. First, we calculated discounted reserves at a number of rates of interest, in order to derive discount factors (calculated as discounted reserves divided by undiscounted reserves). These discount factors are shown in Appendix E.

For a particular syndicate, cohort of underwriting years, rate of interest i, and method for measuring variability, we then calculated the number of standard deviations n, such that

$$(B + n \times S) \times D(i) = B$$

where:

B = best estimate of reserve
S = standard deviation
D(i) = discount factor at rates of interest i

We calculated the value of n for each combination of the following conditions and for a number of different rates of interest.

Syndicate	Cohort of Years	Method
A	1993 – 1997	Bootstrapping – Standard Approach
B	1998	Bootstrapping – Reduced Variability Approach
	1999	Mack
	1993 – 1999	Patel and Raws
		Sanders and Leifer
		Zehnwirth

One of the rates of interest which we considered was 5.3%. The reason that we selected this rate was that this was the rate suggested for discounting in the Inland

Revenue Consultative Document on the 2000 budget proposals for changes to the taxation rules applying to general insurance companies and Lloyd's members [5]. It approximately equates to the current rate on medium to long term gilts.

The table below shows the results of our calculations using the 5.3% rate. For each of the syndicates, cohorts of years and methods of measuring variability, it shows the size of the risk load that offsets the effects of discounting at 5.3%, expressed as a number of standard deviations.

Size of Risk Loads that Offset Effects of Discounting
Expressed as a Number of Standard Deviations
Using a Discount Rate of 5.3%

	Underwriting Years			
Method	1993-1997	1998	1999	1993-1999
Syndicate A - Short Tail				
Bootstrapping - Standard Approach	0.07	0.31	0.36	0.40
Bootstrapping - Reduced Variability Approach	0.26	0.45	0.39	0.57
Mack	0.31	0.71	0.27	0.41
Patel and Raw	1.00	1.36	1.05	1.56
1 Sanders and Leifer	0.12	0.44	0.18	0.28
Zehnwirth	0.34	0.49	0.49	0.71
Syndicate B -Long Tail				
Bootstrapping -Standard Approach	2.93	1.91	0.75	2.12
1 Bootstrapping -Reduced Variability Approach	9.77	4.79	5.46	11.69
Mack	4.53	2.99	0.45	1.44
Pate1 and Raws	9.39	4.00	6.44	11.39
Sanders and Leifer	0.75	1.00	0.72	0.87
zehnwirth	0.79	0.43	0.49	0.98

It will be seen that the results from the different methods for measuring variability are significantly different from one another. This is a consequence of the wide variations in standard deviations which were discussed in section 5.

In showing the results of our investigations in the table above, we have used a discount rate of 5.3%. However, this has been chosen merely as an illustrative rate. The results using different discount rates show the same patterns and lead to similar

conclusions. Appendix G contains graphs illustrating the results obtained from the different methods using different discount rates.

It should be recognised that our approach is an over simplification of the situation. Syndicates tend to assume that the margin created by not discounting reserves allows not only for the uncertainty of claims reserves but also for the uncertainty of other elements of the RITC premium. Nevertheless, we believe that our results are helpful since they give an indication as to the size of the margin created by not discounting, and they provide a way of comparing the results of the various methods for measuring variability which we have considered.

8. CONCLUSIONS

As discussed in section 4, the analysis of the results of our reserving questionnaire showed that there were wide variations in the best estimates derived by different actuaries given the same information. In addition, as discussed in section 5, the results of the various methods used to measure variability showed that, given the same base data and assumptions, different methods led to very different estimates of standard deviations.

As a profession, we may feel that it is not unreasonable for different actuaries to recommend somewhat different reserves and reserve ranges, given the same information. However, we need to bear in mind that this may not seem so reasonable to non-actuarial colleagues, clients and observers. In addition, there is a question as to how big the differences need to get before they cease to be reasonable even from our own perspective.

While it is fair to say that our results are based on highly simplified data, they do, nevertheless, raise significant questions for the profession. If the views of different actuaries and the results of different methods of estimating risk loads really can differ so much, then maybe we should be asking ourselves the following:

- Should we be suggesting that we are in a position to sign-off on the reasonableness of RITC reserves?
- For that matter, how comfortable should we feel with signing-off on the adequacy of solvency reserves?
- And, more generally, should the profession be pushing for actuarial sign-off on the financial condition of general insurance companies?

We would not suggest that our simplified example and the relatively small number of responses to our questionnaire give sufficient information to answer these questions. However, maybe it is time that a larger project was undertaken to address them adequately, possibly as a matter of priority.

But, whatever the answers to the above questions, it is also important to consider that there may be no-one better placed than actuaries to opine on these issues.

While we fully recognise that this paper does not provide any answers to these important questions, we hope that it will at least promote discussion of them.

REFERENCES

APPENDIX A

The following list of references includes, amongst other things, papers describing each of the methods for measuring the variability of claim reserves which we have considered in detail, plus a number of additional approaches.

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[11] Sanders D and Leifer A - Some Estimates on the Standard Deviation of Ultimate Claims when Judgement is Used - 1998 GISG/ASTIN papers.

[12] Verrall RJ - A State Space Representation of the Chain Ladder Linear Model - Journal of the Institute of Actuaries, Volume 116, Part III.

[13] Sherman RL - Estimating the Variability of Loss Reserves - Casualty Actuarial Society Forum Fall 1998, Casualty Actuarial Society, 1998.

[14] Zehnwirth B – Probabilistic Development Factor Models with Application to Loss Reserve Variability, Prediction Intervals and Risk Based Capital – CAS Forum, Spring 1994, Volume 2.

RITC WORKING PARTY RESERVING COMPETITION APPENDIX B

BACKGROUND

Capital to support Lloyd's syndicates is provided by Names on an annual venture basis. This means that each syndicate year of account is a separate economic entity, and may have a different mix of Names from its predecessor and its successor.

At the end of three years, a year of account closes into its successor year by paying it a reinsurance to close (RITC) premium. The process of closure is intended to provide finality to the Names on the closing year. The main component of the RITC premium is in respect of the claim reserves for the closing year and prior years. In these examples, 1993 to 1996 have already closed into 1997, 1997 is closing into 1998, and 1998 and 1999 are remaining open.

Setting syndicate reserves is the responsibility of the syndicate's managing agent. The Board of the managing agency is required to ensure that that RITC premium (and hence the reserves) is fair and equitable to both parties. If the closing reserve is too low, it is unfair to the accepting Names; if it is too high, it is unfair to the ceding Names.

Currently, the solvency reserves proposed by the managing agent are subject to an actuarial opinion as to their adequacy. In giving this opinion, the actuary must consider the closing year (1997 and prior in this example) and each open year separately. This one-sided opinion protects the accepting Names (the closing year reserves should not be too low) but not the ceding Names.

It is possible that Lloyd's may consider moving to a two-sided actuarial opinion. Then, the actuary would be required to assess both the adequacy and the reasonableness of the reserves proposed by the managing agent, i.e. are they fair and equitable to both sets of Names?

SYNDICATE A

Type of business

Property – direct, reinsurance and retrocessional.

Location

Mainly USA and the Caribbean.

Notes

1998 year of account heavily hit by Hurricane Georges.

1999 year has been affected by an unusually high frequency of smaller catastrophes.

SYNDICATE B

Type of business

Claims made casualty – D&O, PI and medical malpractice.

Location

Mainly USA.

SIMPLIFYING ASSUMPTIONS (BOTH SYNDICATES)

- Premium on all years is fully developed.
- No reinsurance is purchased.
- Assume no ULAE.
- No further information is available.

ENTRY FORM

PERSONAL DETAILS

Please complete the following details. Some of this information will be used to determine if there are any statistically significant differences in the results from different subsets of the population returning these forms.

Name: .....
Company: .....
Address: .....
.....
.....
.....
Tel: .....

Email: .....
.....

Practising Cert.for Lloyd's Opinions: Y/N
Area of work: Lloyd's Market
London Market
Consultancy (Lloyd's/ London Market)
Consultancy (Other)
Other
Qualification Status: > 5 years FIA/FFA
2-5 years FIA/FFA
0-2 years FIA/FFA
Student

ANSWERS (to nearest £k)

1. What is your best estimate reserve at 31/12/1999 for:

	Syndicate A		Syndicate B	
(a)	1997 and prior	.....	(d) 1997 and prior	.....
(b)	1998	.....	(e) 1998	.....
(c)	1999	.....	(f) 1999	.....

2. What is the lowest reserve you would sign off as adequate at 31/12/1999 for:

	Syndicate A		Syndicate B	
(a)	1997 and prior	.....	(d) 1997 and prior	.....
(b)	1998	.....	(e) 1998	.....
(c)	1999	.....	(f) 1999	.....

3. What is the highest reserve you would sign off as reasonable at 31/12/1999 for:

	Syndicate A		Syndicate B	
(a)	1997 and prior	.....	(d) 1997 and prior	.....
(b)	1998	.....	(e) 1998	.....
(c)	1999	.....	(f) 1999	.....

PRIZE

A prize will be awarded by random selection of one respondent. Working Party members are excluded. The prize will comprise of £1 of wine vouchers for every entrant returning a form (including Working Party members) to a maximum of £100.

SYNDICATE A (SHORT TAIL)

	Incurred							Exposure	
	1	2	3	4	5	6	7	Paid	Index
1993	8,920	26,802	31,282	29,523	29,006	28,863	28,645	27,933	100
1994	19,072	34,513	35,655	35,532	35,542	35,032		34,081	102
1995	15,510	24,280	25,863	25,980	25,283			24,244	103
1996	4,688	17,300	19,930	19,995				19,100	106
1997	8,137	27,234	30,588					26,243	110
1998	20,276	54,765						26,969	115
1999	28,634							3,533	119

All figures in Conv. £000

	Ratios					
	1-2	2-3	3-4	4-5	5-6	6-7
1993	3.005	1.167	0.944	0.982	0.995	0.992
1994	1.810	1.033	0.997	1.000	0.986	
1995	1.565	1.065	1.005	0.973		
1996	3.690	1.152	1.003			
1997	3.347	1.123				
1998	2.701					
Overall	**2.414**	**1.101**	**0.985**	**0.987**	**0.990**	**0.992**

SYNDICATE B (LONG TAIL)

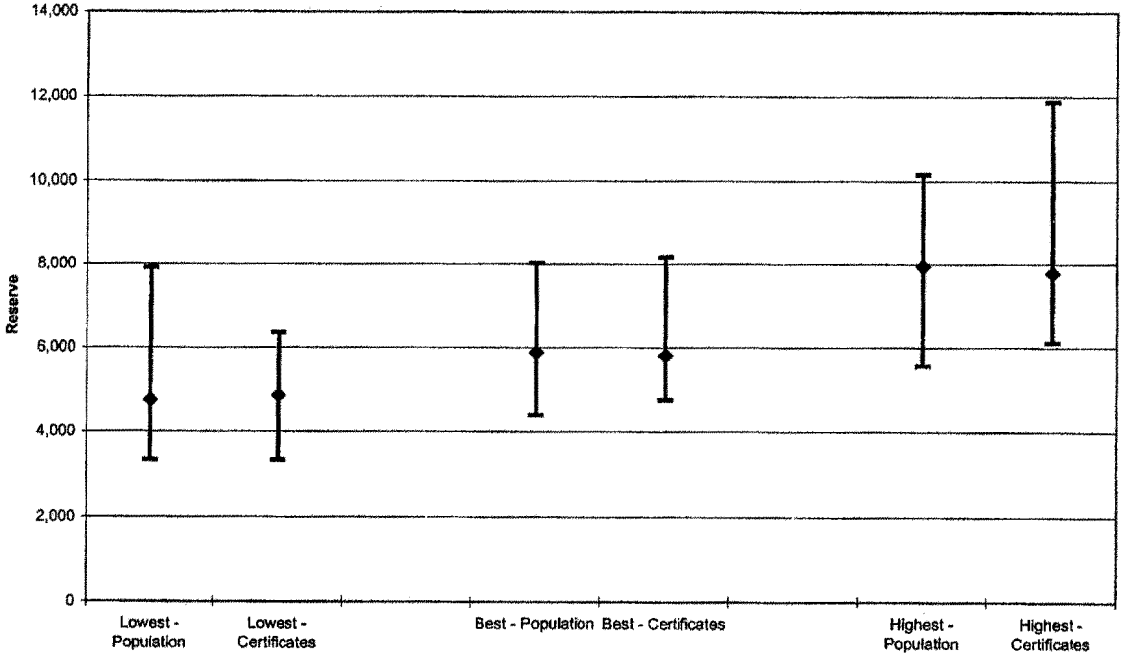
	Incurred							Exposure	
	1	2	3	4	5	6	7	Paid	Index
1993	891	7,308	14,216	23,202	23,540	26,181	27,382	24,849	100
1994	2,979	12,847	22,759	34,199	36,510	40,400		32,476	102
1995	1,497	20,067	40,292	55,119	60,205			40,088	104
1996	612	23,378	43,353	61,923				27,760	105
1997	2,290	26,882	48,765					5,974	107
1998	2,298	21,770						1,336	108
1999	2,322							235	110

All figures in Conv. £000

	Ratios					
	1-2	2-3	3-4	4-5	5-6	6-7
1993	8.202	1.945	1.632	1.015	1.112	1.046
1994	4.313	1.772	1.503	1.068	1.107	
1995	13.405	2.008	1.368	1.092		
1996	38.189	1.854	1.428			
1997	11.741	1.814				
1998	9.472					
Overall	**10.623**	**1.872**	**1.446**	**1.069**	**1.109**	**1.046**

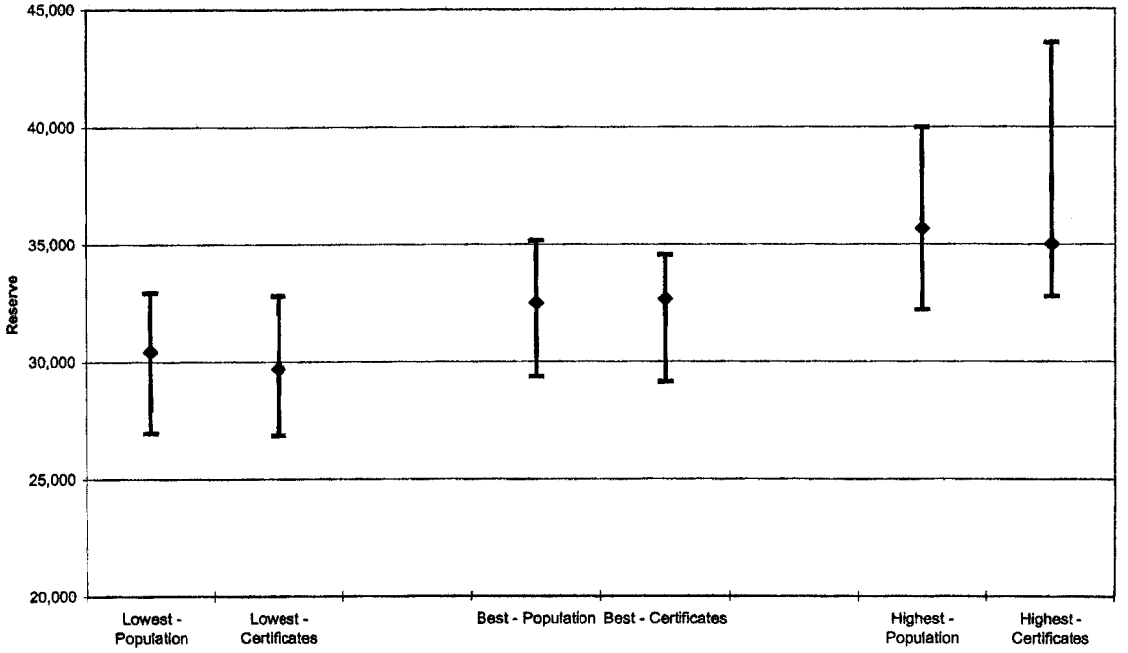
Reserving Exercise Results - Syndicate A - 1997 & Prior

Graph Showing Medians, 10th Percentiles and 90th Percentiles



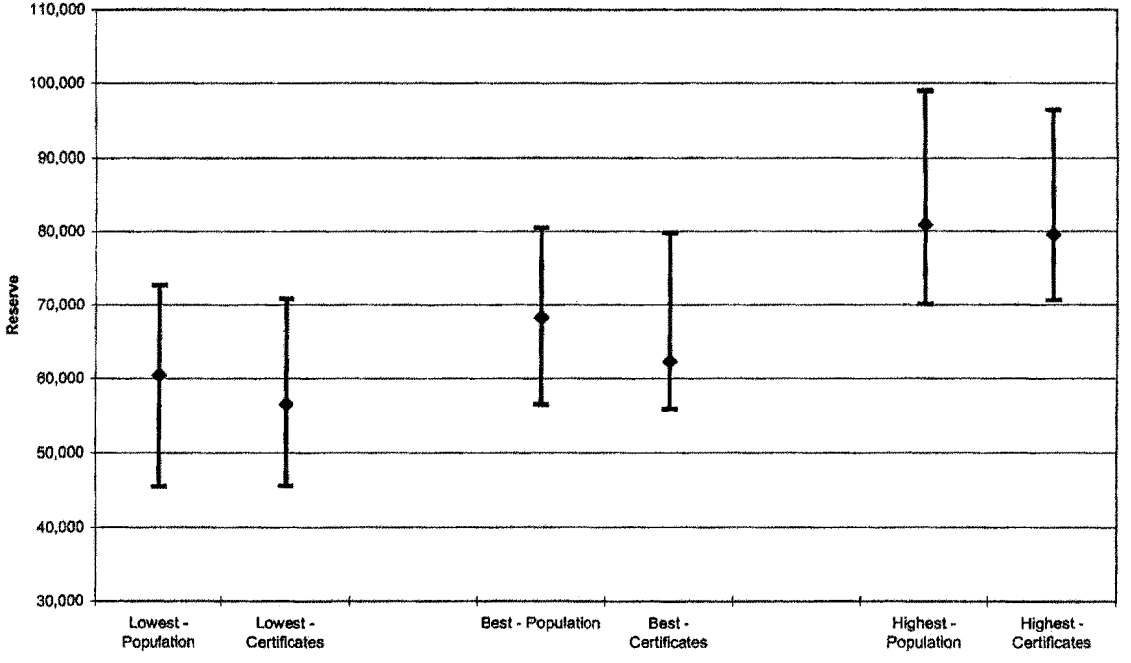
Reserving Exercise Results - Syndicate A - 1998

Graph Showing Medians, 10th Percentiles and 90th Percentiles



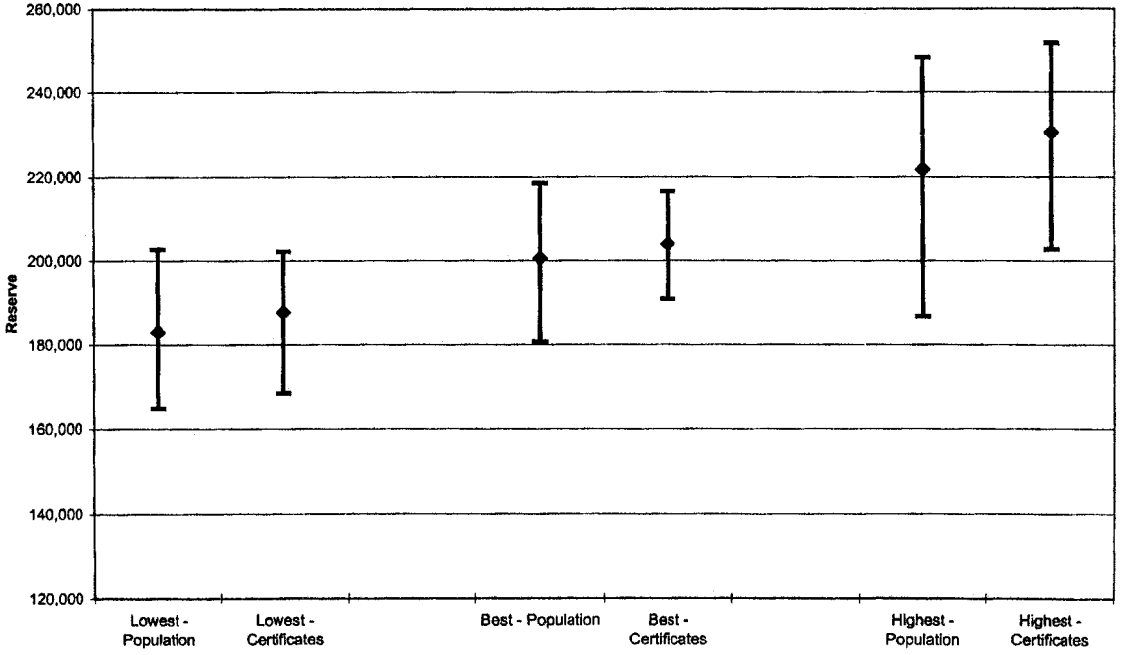
Reserving Exercise Results - Syndicate A - 1999

Graph Showing Medians, 10th Percentiles and 90th Percentiles



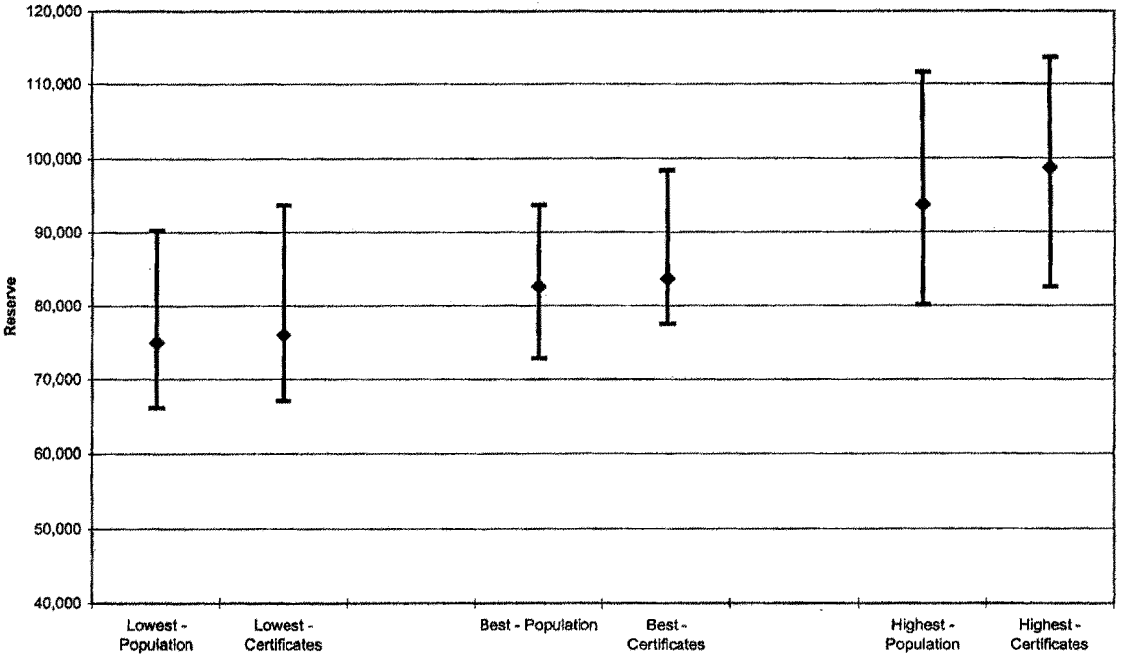
Reserving Exercise Results - Syndicate B - 1997 & Prior

Graph Showing Medians, 10th Percentiles and 90th Percentiles



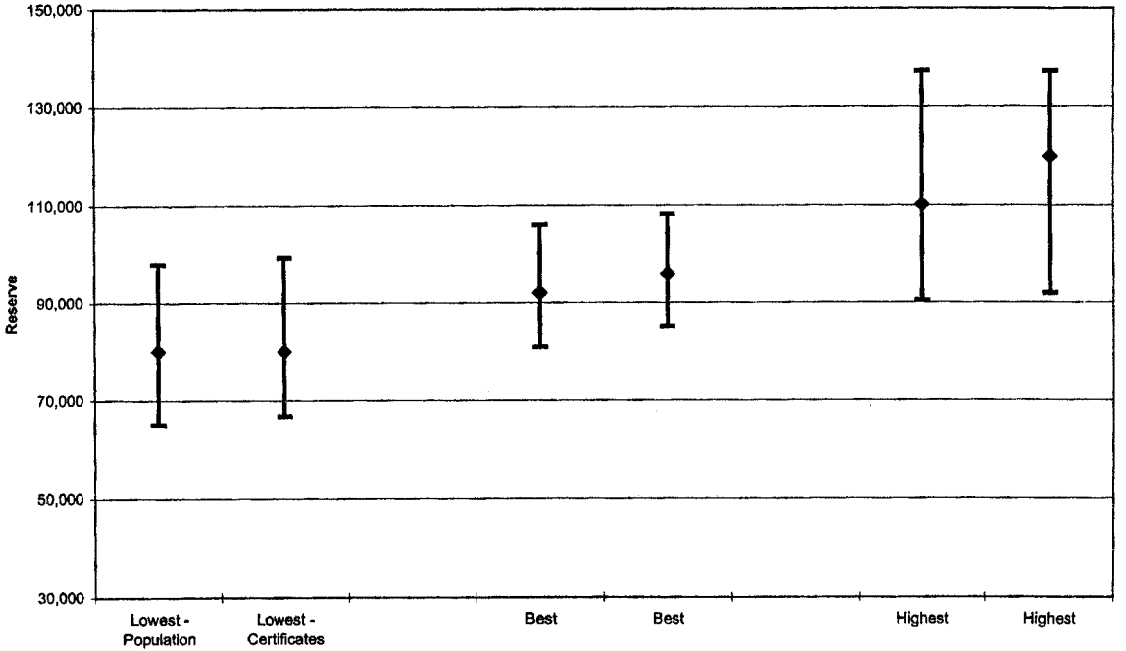
Reserving Exercise Results - Syndicate B - 1998

Graph Showing Medians, 10th Percentiles and 90th Percentiles



Reserving Exercise Results - Syndicate B - 1999

Graph Showing Medians, 10th Percentiles and 90th Percentiles



Syndicate A
SHORT TAIL

As at 31st December 1999
Values in Pounds Sterling

Projection Summary

Underwriting Year (1)	Selected Ultimate Claims (2)	Outstanding Claims (3)	Reported IBNR Claims (4)	Unpaid Claims (5)
1993	28,645	712	0	712
1994	34,682	951	(350)	601
1995	24,780	1,039	(503)	536
1996	19,401	895	(594)	301
1997	29,739	4,345	(849)	3,496
1998	58,569	27,796	3,804	31,600
1999	67,528	25,101	38,894	63,995
Total	263,344	60,839	40,402	101,241

	Estimated Ultimate Exposure Based on						
Underwriting Year (1)	Paid Development Method (6)	Incurred Development Method (7)	Paid BF Method (8)	Incurred BF Method (9)	Expected Claim Ratio Method (10)	Initial Expected Exposure Ratio (11)	Selected Ultimate Exposure Ratio (12)
1993	28,771	28,645	28,767	28,645	28,645	286.450	286.450
1994	35,454	34,682	35,425	34,682	34,682	340.016	340.016
1995	25,599	24,780	25,556	24,780	24,780	240.581	240.581
1996	20,571	19,401	20,487	19,401	19,401	183.030	183.030
1997	31,091	29,739	30,880	29,739	29,739	270.353	270.353
1998	51,121	58,569	54,640	58,569	58,569	509.297	509.297
1999	30,137	82,682	56,058	67,528	59,500	500.000	567.465
Total	222,745	278,498	251,813	263,344	255,316		

	Original Data			Expected Percentage of Ultimate			Paid	Incurred
Underwriting Year (1)	Exposure Index (13)	Paid Claims (14)	Incurred Claims (15)	Exposure Index (16)	Claims Paid (17)	Claims Incurred (18)	Exposure Ratio (19)	Exposure Ratio (20)
1993	100	27,933	28,645	100.0%	97.1%	100.0%	279.330	286.450
1994	102	34,081	35,032	100.0%	96.1%	101.0%	334.127	343.451
1995	103	24,244	25,283	100.0%	94.7%	102.0%	235.379	245.466
1996	106	19,100	19,995	100.0%	92.8%	103.1%	180.189	188.632
1997	110	26,243	30,588	100.0%	84.4%	102.9%	238.573	278.073
1998	115	26,969	54,765	100.0%	52.8%	93.5%	234.513	476.217
1999	119	3,533	28,634	100.0%	11.7%	34.6%	29.688	240.622
Total	755	162,103	222,942					

Syndicate A

SHORT TAIL

As at 31st December 1999
Values in Pounds Sterling

Paid Claims

Underwriting Year	Development Year 1	2	3	4	5	6	7
1993	1,876	15,689	22,954	25,756	27,157	27,639	27,933
1994	8,236	24,509	30,323	32,970	33,544	34,081	
1995	6,817	19,589	23,647	24,993	24,244		
1996	2,334	10,435	16,747	19,100			
1997	2,121	14,986	26,243				
1998	6,831	26,969					
1999	3,533						

Underwriting Year	Report to Report Development Factors 1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - Ult
1993	8.363	1.463	1.122	1.054	1.018	1.011	
1994	2.976	1.237	1.087	1.017	1.016		
1995	2.874	1.207	1.057	0.970			
1996	4.471	1.605	1.141				
1997	7.065	1.751					
1998	3.948						
1999							
Simple Average - All	4.949	1.453	1.102	1.014	1.017	1.011	
Volume Weighted Average - All	3.976	1.407	1.098	1.015	1.017	1.011	
Selected Factors	**4.500**	**1.600**	**1.100**	**1.020**	**1.015**	**1.010**	**1.030**

Syndicate A

SHORT TAIL

As at 31st December 1999
Values in Pounds Sterling

Incurred Claims

Underwriting Year	Development Year 1	2	3	4	5	6	7
1993	8,920	26,802	31,282	29,523	29,006	28,863	28,645
1994	19,072	34,513	35,655	35,532	35,542	35,032	
1995	15,510	24,280	25,863	25,980	25,283		
1996	4,688	17,300	19,930	19,995			
1997	8,137	27,234	30,588				
1998	20,276	54,765					
1999	28,634						

Underwriting Year	Report to Report Development Factors 1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - Ult
1993	3.005	1.167	0.944	0.982	0.995	0.992	
1994	1.810	1.033	0.997	1.000	0.986		
1995	1.565	1.065	1.005	0.973			
1996	3.690	1.152	1.003				
1997	3.347	1.123					
1998	2.701						
1999							
Simple Average - All	2.686	1.108	0.987	0.985	0.990	0.992	
Volume Weighted Average - All	2.414	1.101	0.985	0.987	0.990	0.992	
Selected Factors	**2.700**	**1.100**	**1.002**	**0.990**	**0.990**	**0.990**	**1.000**

Syndicate B
LONG TAIL

As at 31st December 1999
Values in Pounds Sterling

Projection Summary

Underwriting Year (1)	Selected Ultimate Claims (2)	Outstanding Claims (3)	Reported IBNR Claims (4)	Unpaid Claims (5)
1993	31,489	2,533	4,107	6,640
1994	48,783	7,924	8,383	16,307
1995	77,786	20,117	17,581	37,698
1996	88,007	34,163	26,084	60,247
1997	100,494	42,791	51,729	94,520
1998	85,240	20,434	63,470	83,904
1999	100,009	2,087	97,687	99,774
Total	531,809	130,049	269,042	399,091

	Estimated Ultimate Exposure Based on						
Underwriting Year (1)	Paid Development Method (6)	Incurred Development Method (7)	Paid BF Method (8)	Incurred BF Method (9)	Expected Claim Ratio Method (10)	Initial Expected Exposure Ratio (11)	Selected Ultimate Exposure Ratio (12)
1993	34,789	31,489	33,846	31,489	31,489	314.893	314.893
1994	50,013	48,783	49,582	48,783	48,783	478.265	478.265
1995	74,083	77,786	75,782	77,786	77,786	747.946	747.946
1996	76,951	88,007	84,018	88,007	88,007	838.159	838.159
1997	37,260	100,494	90,355	100,494	100,494	939.196	939.196
1998	21,248	85,240	81,216	85,240	85,240	789.260	789.260
1999	37,375	100,009	99,615	100,009	100,009	909.175	909.175
Total	331,718	531,809	514,415	531,809	531,809		

	Original Data			Expected Percentage of Ultimate			Paid	Incurred
Underwriting Year (1)	Exposure Index (13)	Paid Claims (14)	Incurred Claims (15)	Exposure Index (16)	Claims Paid (17)	Claims Incurred (18)	Exposure Ratio (19)	Exposure Ratio (20)
1993	100	24,849	27,382	100.0%	71.4%	87.0%	248.490	273.820
1994	102	32,476	40,400	100.0%	64.9%	82.8%	318.392	396.078
1995	104	40,088	60,205	100.0%	54.1%	77.4%	385.462	578.894
1996	105	27,760	61,923	100.0%	36.1%	70.4%	264.381	589.743
1997	107	5,974	48,765	100.0%	16.0%	48.5%	55.832	455.748
1998	108	1,336	21,770	100.0%	6.3%	25.5%	12.370	201.574
1999	110	235	2,322	100.0%	0.6%	2.3%	2.136	21.109
Total	736	132,718	262,767					

Syndicate B

LONG TAIL

As at 31st December 1999
Values in Pounds Sterling

Paid Claims

Underwriting Year	Development Year 1	2	3	4	5	6	7
1993	77	2,419	5,915	10,757	18,331	22,599	24,849
1994	207	4,096	8,629	18,757	27,906	32,476	
1995	367	5,767	16,827	28,785	40,088		
1996	60	2,189	7,492	27,760			
1997	467	3,131	5,974				
1998	693	1,336					
1999	235						

Report to Report Development Factors

Underwriting Year	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - Ult
1993	31.416	2.445	1.819	1.704	1.233	1.100	
1994	19.787	2.107	2.174	1.488	1.164		
1995	15.713	2.918	1.711	1.393			
1996	36.545	3.423	3.705				
1997	6.705	1.908					
1998	1.927						
1999							
Simple Average - All	18.682	2.560	2.352	1.528	1.198	1.100	
Volume Weighted Average - All	10.120	2.547	2.214	1.481	1.191	1.100	
Selected Factors	**10.000**	**2.550**	**2.250**	**1.500**	**1.200**	**1.100**	**1.400**

Syndicate B

LONG TAIL

As at 31st December 1999
Values in Pounds Sterling

Incurred Claims

Underwriting Year	Development Year 1	2	3	4	5	6	7
1993	891	7,308	14,216	23,202	23,540	26,181	27,382
1994	2,979	12,847	22,759	34,199	36,510	40,400	
1995	1,497	20,067	40,292	55,119	60,205		
1996	612	23,378	43,353	61,923			
1997	2,290	26,882	48,765				
1998	2,298	21,770					
1999	2,322						

Underwriting Year	Report to Report Development Factors 1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - Ult
1993	8.202	1.945	1.632	1.015	1.112	1.046	
1994	4.313	1.772	1.503	1.068	1.107		
1995	13.405	2.008	1.368	1.092			
1996	38.189	1.854	1.428				
1997	11.741	1.814					
1998	9.472						
1999							
Simple Average - All	14.220	1.879	1.483	1.058	1.109	1.046	
Volume Weighted Average - All	10.623	1.872	1.446	1.069	1.109	1.046	
Selected Factors	**11.000**	**1.900**	**1.450**	**1.100**	**1.070**	**1.050**	**1.150**

Discount Factors

Syndicate A - Short Tail

	Underwriting Years			
Discount Rate	1993-1997	1998	1999	1993-1999
1%	0.976	0.987	0.985	0.985
2%	0.954	0.974	0.971	0.971
3%	0.933	0.962	0.958	0.957
4%	0.913	0.950	0.945	0.945
5%	0.894	0.939	0.932	0.932
5.3%	0.888	0.936	0.928	0.928
6%	0.876	0.928	0.920	0.920
7%	0.859	0.918	0.908	0.909
8%	0.843	0.908	0.897	0.898
9%	0.828	0.899	0.886	0.887
10%	0.814	0.890	0.876	0.877

Syndicate B - Long Tail

	Underwriting Years			
Discount Rate	1993-1997	1998	1999	1993-1999
1%	0.961	0.957	0.951	0.958
2%	0.925	0.918	0.906	0.919
3%	0.893	0.883	0.864	0.884
4%	0.863	0.850	0.826	0.851
5%	0.835	0.819	0.792	0.821
5.3%	0.827	0.811	0.782	0.812
6%	0.810	0.791	0.759	0.793
7%	0.786	0.765	0.729	0.767
8%	0.764	0.741	0.702	0.743
9%	0.743	0.718	0.676	0.721
10%	0.724	0.696	0.651	0.700

Standard Deviations Derived From Different Methods of Measuring Variability

Values in Pounds Sterling

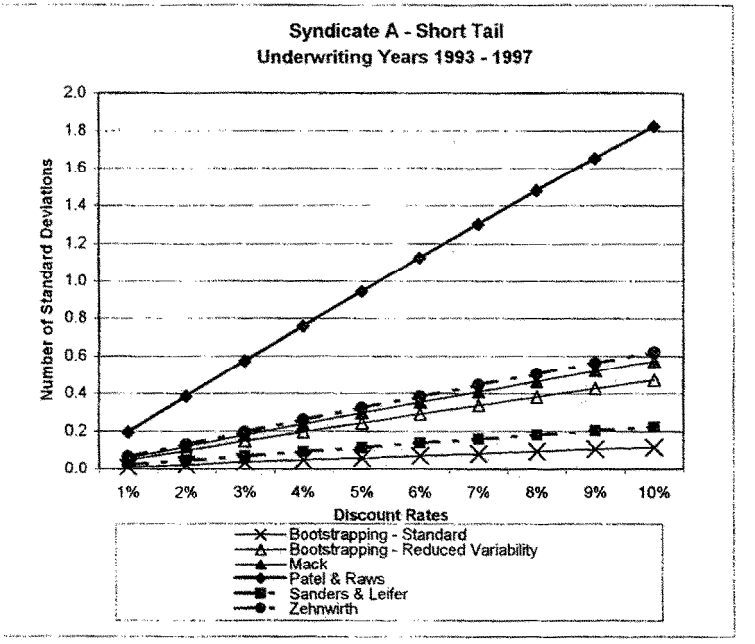
Syndicate A - Short Tail

	Underwriting Years			
Method	**1993-1997**	**1998**	**1999**	**1993-1999**
Bootstrapping - Standard	10,900	6,989	13,527	19,480
Bootstrapping - Reduced Variability	2,740	4,827	12,516	13,686
Mack	2,255	3,070	18,446	19,036
Patel & Raws	709	1,604	4,683	5,018
Sanders & Leifer	5,744	4,948	27,921	27,829
Zehnwirth	2,076	4,489	10,079	11,059

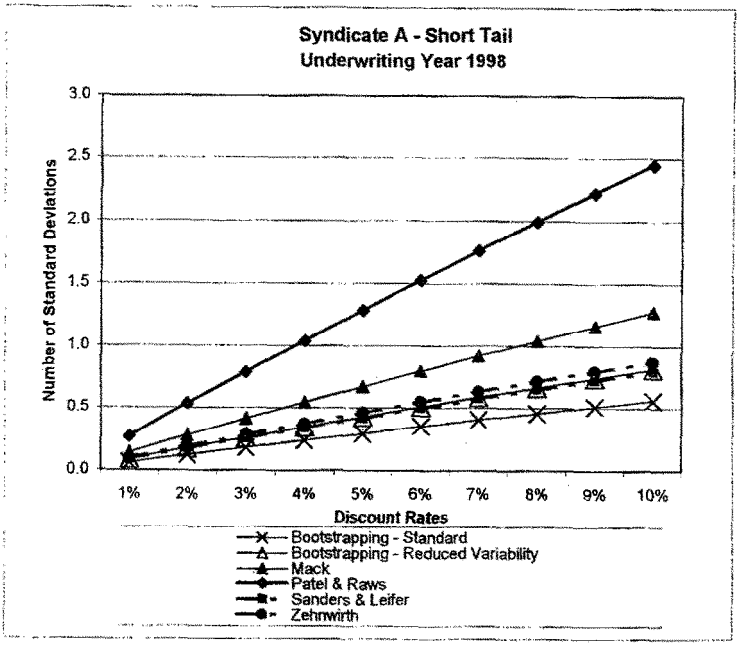
Syndicate B - Long Tail

	Underwriting Years			
Method	**1993-1997**	**1998**	**1999**	**1993-1999**
Bootstrapping - Standard	15,346	10,258	37,415	43,450
Bootstrapping - Reduced Variability	4,596	4,084	5,103	7,878
Mack	9,911	6,546	62,595	63,900
Patel & Raws	4,783	4,898	4,330	8,086
Sanders & Leifer	60,287	19,668	38,579	105,492
Zehnwirth	56,749	45,675	56,569	93,985

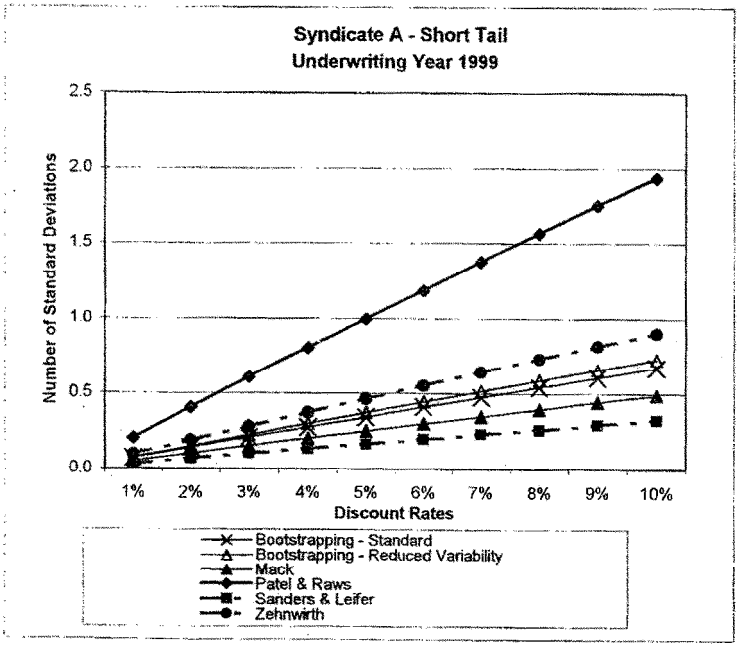
Size of Risk Loads that Offset Effects of Discounting Expressed as a Number of Standard Deviations



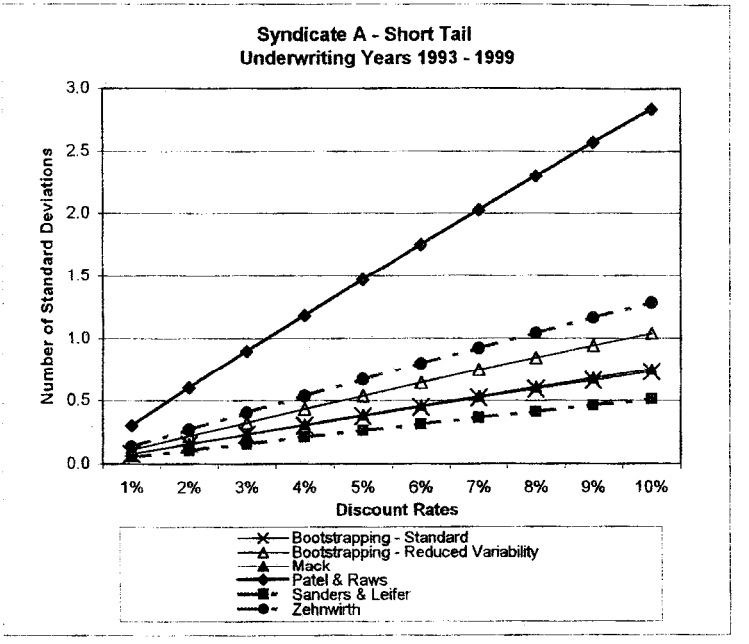
Size of Risk Loads that Offset Effects of Discounting Expressed as a Number of Standard Deviations



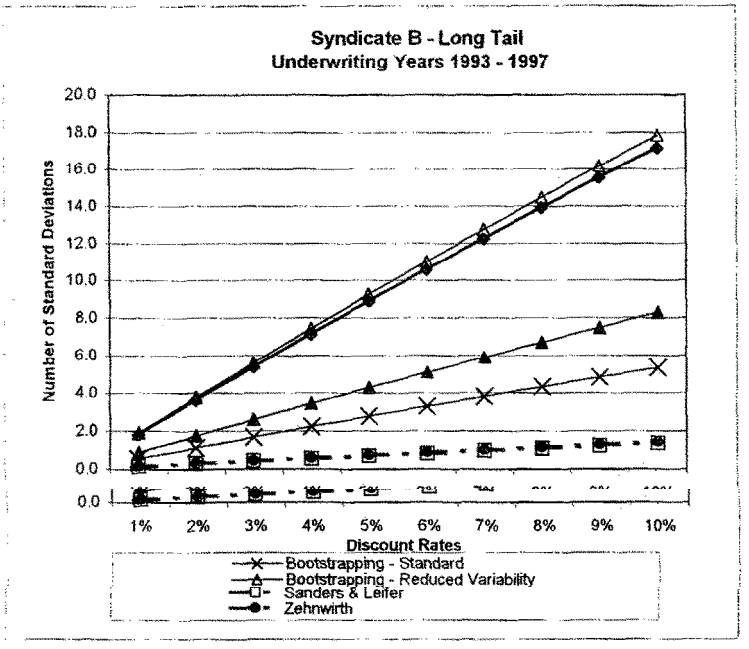
Size of Risk Loads that Offset Effects of Discounting Expressed as a Number of Standard Deviations



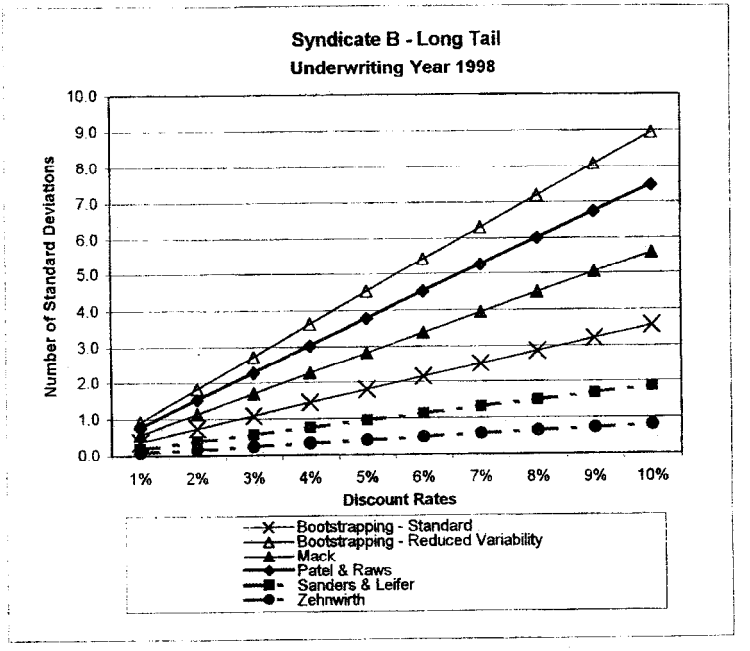
Size of Risk Loads that Offset Effects of Discounting Expressed as a Number of Standard Deviations



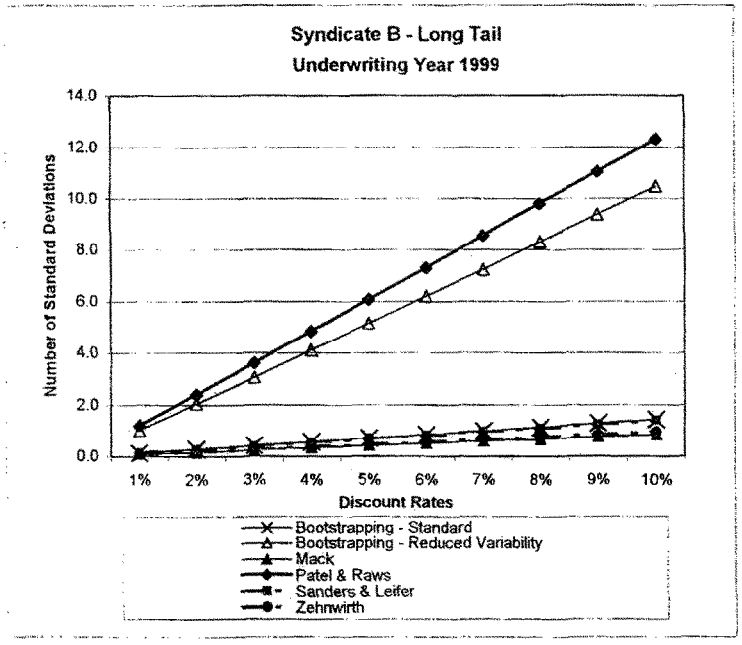
Size of Risk Loads that Offset Effects of Discounting Expressed as a Number of Standard Deviations



Size of Risk Loads that Offset Effects of Discounting Expressed as a Number of Standard Deviations



Size of Risk Loads that Offset Effects of Discounting Expressed as a Number of Standard Deviations



Size of Risk Loads that Offset Effects of Discounting Expressed as a Number of Standard Deviations