LOSS RESERVES IN THE LONDON MARKET

BY G. P. M. MAHER, B.A., F.I.A.

[Presented to the Institute of Actuaries, 27 March 1995]

ABSTRACT

This paper addresses the process of estimating loss reserves for a company or syndicate writing in the London Market. Particular emphasis is placed on insurers maximising the value of the process, and ensuring that the process is not simply a series of mathematical calculations. The use of sophisticated mathematical techniques should not distract from the importance of understanding the business and ensuring that data are correct. Sophisticated mathematical techniques can give rise to misleading impressions of confidence and accuracy to estimates, which are often subject to considerable uncertainty. The principles (rather than the detailed techniques) are illustrated by a case study based on a hypothetical London Market writer. Many of these principles are relevant to other markets.

KEYWORDS

Loss Reserves; Loss Ratios; London Market; Projections; Triangulations; Data; Reconciliation; Exposure; Claims; Premiums; Reinsurance; Uncertainty

1. INTRODUCTION

1.1 Loss reserving is the process of estimating, at a particular time ('the evaluation date'), an insurer's liability to pay claims in the future on policies issued as at the evaluation date. The area of loss reserving for insurers and reinsurers of non-life business (collectively 'insurers' in this paper) is one in which the actuarial profession is increasingly involved. It is an area of great importance to the financial stability and profitability of these insurers, since it involves the estimation of the most important components of the balance sheet. The sound estimation of loss reserves is critical to the management and planning of the company's future business, because it provides an evaluation of the historic profitability of the insurer's business.

1.2 This paper emphasises the importance of the reserving process as an investigative exercise which relies on both quantitative and qualitative information. The estimation of loss reserves is an overall investigation into the financial performance of the insurance company. In order for this investigation to be effectively carried out, input is required from all areas of the company's operation.

1.3 The flow of information within a company is part of the role of management, varies within different corporate cultures and depends on the type and structure of the insurer. It is not necessary that, in every company, each department should have full access to all available information. Indeed, in some cases this can be harmful. Where claims handlers set case estimates based on subjective judgements, inconsistent or irregular feedback on the adequacy of these estimates can significantly affect the manner in which estimates are established, and reduce the usefulness of case reserve information available to management.

689

1.4   Each function in the company can have input to the process, and can be provided with feedback on future developments. Management can be provided with information on the contribution to profitability of the prior years' operations. The actuary can have access to information on developments within the company. Underwriters can be provided with estimates of contributions to profitability, and can be provided with claim development patterns and other benchmarks which are useful for underwriting.   The accounting department can be provided with reports which assist in the assessment and understanding of financial performance and the budgeting for the coming year. Claims handling personnel can have the benefit of advice on how to monitor emerging losses or other claims developments.   The data processing department can have recommendations on data capturing developments required.
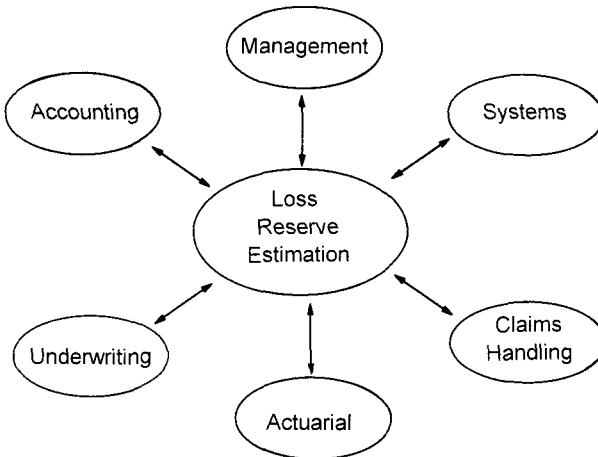

Figure 1.1. The loss reserving process

1.5   This paper is written from the perspective of the practitioner.   It is intended to present practice rather than theory, and to set out some of the techniques used on a day-to-day basis.   Many of these techniques are mathematically simple, partly because of the complexity of the business and partly because of the nature of the data to which these techniques are applied. Despite its mathematical simplicity, the application can be complex in practice. Indeed, the mathematical simplicity of the techniques is an advantage, enabling more emphasis to be placed on understanding the business, which is often the most important and time-consuming part of the loss reserving process.   This paper does not, and cannot, cover all or most of the actuarial aspects of loss reserving in this market. There are a number of areas where further papers could usefully be written. Such papers, if written so as to enable the practitioner to provide better services to his clients or employers, would be invaluable.

2. FEATURES OF THE MARKET

2.1 *Overview*

2.1.1 The London Market consists of insurers and reinsurers writing business worldwide, and often of a highly specialised nature. The principal centres of operation are Lloyd's of London, the London Underwriting Centre (LUC) and the Institute of London Underwriters (ILU), which bring competing insurers into close proximity. These buildings are within walking distance of each other, which is important for brokers placing business or handling claims. The streets in this area contain the offices of many insurers, including the London branches of most well-known insurance companies. The market consists of Lloyd's syndicates, insurance companies (the company market) and Protection and Indemnity Clubs (P&I Clubs). Figure 2.1 shows premium income for recent years.

Mix of Business of the London Insurance Market
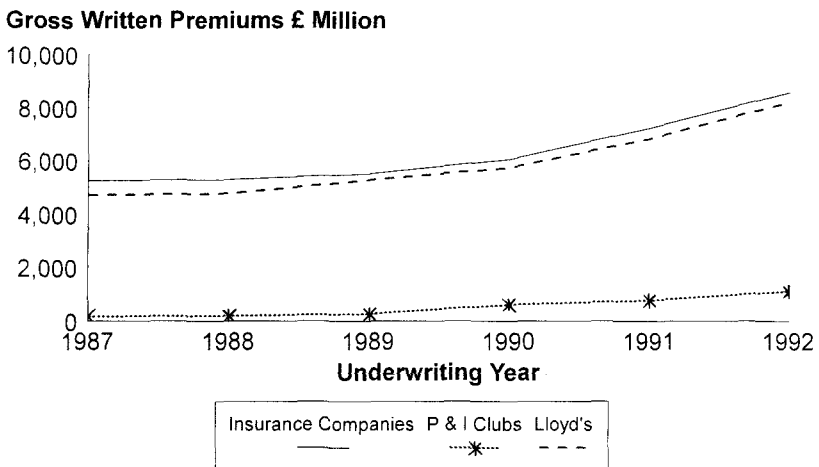
Gross Written Premiums £ Million

Figure 2.1. London Market premium income

Premium income figures shown in Figure 2.1 are gross of commission and are before outwards reinsurance. The data have been taken from Carter & Falush (1994), which provides an excellent overview of the London market.

2.1.2 The London Market insurance company or syndicate does not typically have a large staff, and its operation centres around the underwriter, who has a role which is of considerably greater importance than that of underwriters in other markets. Typically, the underwriter is a specialist in his field, with a wide

network of contacts. The broker is central to the operation of the market, heavily involved in the design of products and carrying on much of the claims handling. Figure 2.2 illustrates the structure of the market. The distribution of business shown in Figure 2.2 is based on the Lloyd's mix of business for 1992, and is based on data set out in Carter & Falush.

Legend:

Outer Ring - Sources
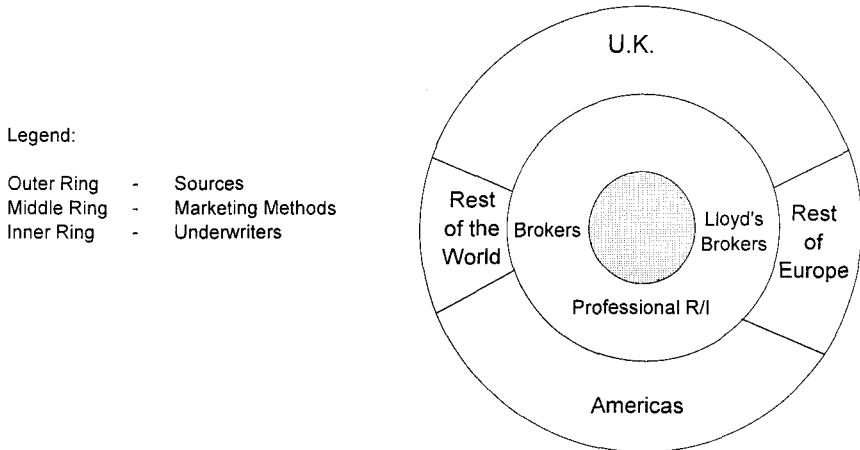Middle Ring - Marketing Methods
Inner Ring - Underwriters

Figure 2.2. Schematic diagram of the London Market

2.2 *Business Written*

2.2.1 The business written is typically classified, both at Lloyd's and elsewhere, as Marine, Aviation and Non-Marine business. Non-Marine business covers property and liability business. There is a large concentration of United States business, which has been one of the sources of recent problems. The market generally attracts business which is specialised. Its competitive advantages are the underwriters with sufficient experience to assess their risks and the concentration of capacity willing to write this business.

2.2.2 Business is placed around the market by brokers. Typically, the broker puts together a presentation and agrees terms and conditions with the lead underwriter, who takes a percentage of the risk. The broker then presents the 'slip' (which summarises the terms and conditions) around the rest of the market to make up his 100%. He may often place more than 100% and then 'sign down'. The name of the lead underwriter often assists the broker in placing his business around the following market. Indeed, some writers may decline to follow if the slip does not contain the name of an underwriter whose experience they value.

2.2.3 The placing of an individual large risk will usually be carried out in this fashion. It is, however, a laborious process, and other methods are also used. The lineslip is one such example. Broadly speaking, the broker puts together a 'market', consisting of insurers who each agree to take a stated percentage of each

risk bound to the lineslip. The terms on which they bind themselves vary widely. Sometimes the lead underwriter agrees the terms and conditions of each risk with the broker, and his agreement is binding on the following market.

2.2.4   Other methods of placing business are used, particularly for low premium lines such as personal accident. In such cases, the broker agrees a rate manual with the market, and is then generally free to write to that manual with certain restrictions, particularly on volume of business written.

2.2.5   In the London Market, business is written as either direct insurance or reinsurance. Often the terms under which the direct business is written make it almost identical to reinsurance business. For example, the insurance of the products liability of a Fortune 500 company is generally subject to large deductibles and other conditions, which make it equivalent to excess of loss reinsurance business.

2.2.6   The types of coverage include, on the liability side, insurance of manufacturers, utilities, professional bodies and medical malpractice, amongst others. Coverage on property risks will include direct exposure to catastrophes as an insurer, direct reinsurance of such a portfolio and worldwide retrocessional exposure.

2.2.7   The nature of the business, particularly the way in which it is placed, often leads to difficulties with data. The data may be limited. In the case of business written by a following underwriter, there may be little information available on the original risk other than what was recorded on the slip. Information available on business written on a lineslip basis may be even more limited. Data quality is almost always a problem for the actuary, and the London Market is no exception.

2.3 *Market Problems*

2.3.1 The market has been faced with a number of problems, which have been the cause of the losses at Lloyd's (and elsewhere in the market), and also for the withdrawal from the market of some overseas and domestic capacity.

2.3.2 The occurrence of large natural catastrophes in heavily insured regions, during the period 1987 to 1992, resulted in large claims to the market. These claims, which 'spiralled' around the market, exceeded the reinsurance programmes of some underwriters, largely because they had carried out inadequate exposure monitoring. In the absence of this information, they were not fully aware of the quantum of risk that they had assumed and, as a result, purchased insufficient reinsurance.

2.3.3 Asbestos and pollution claims, which present particularly challenging reserving issues, emanate almost entirely, at this stage, from the United States of America. Asbestos claims are being made against manufacturers, producers and users of asbestos, and have been a problem for the market for some time.

2.3.4 The problems of pollution result from the U.S. Superfund Act, which imposed liability retroactively on generators of hazardous waste (and others) who, in turn, sought coverage under old general liability policies. The legislation has

resulted in numerous court actions to resolve disputes, including disputes on coverage which, from the point of view of insurers and reinsurers, have had varying degrees of success.

2.3.5   The market provided coverage to professional firms, such as accountants, against claims from third parties. Corporate failure in the U.S.A. and elsewhere, partly the result of recession, but also for more specific reasons, such as the failure of many U.S. savings and loans institutions, has presented the market with significant losses and reserving problems.

2.3.6 Some of the problems facing the market, and a cause of corporate failure and syndicate collapse, are, however, more fundamental in nature.   Losses experienced in the marine and aviation markets are, partly at least, the result of inadequate pricing. Inadequate reserving disciplines, particularly at Lloyd's, where the reserving exercise does not formally take place until three years after the business was written, enabled some of this business to continue to be written for longer than, perhaps, would otherwise have been the case. This is particularly the case with longer-tailed lines of business, for which results are heavily dependent for many years on the results of the reserving exercise.

2.3.7 The following sections describe the general approach to estimating loss reserves.   This paper does not set out to provide solutions to the different reserving problems facing the market.   Rather, this paper focuses on the principles and practicalities of the reserving exercise in this market.

3. UNDERSTANDING THE BUSINESS

3.1 *Introduction*

3.1.1 The first, and most important, aspect of successful loss reserving is to understand the underlying business. No one, whether actuary, claims manager or underwriter, can estimate loss reserves unless they have a basic understanding of the business that the insurer is underwriting, particularly since nothing ever stays the same. As part of the estimation process, the actuary will, therefore, normally have discussions with staff from the underwriting, claims handling and reinsurance departments. The purpose of these discussions is to develop an understanding of changes during the year relevant to the loss reserving process, and also to build up a picture of the history of the insurer and its operations.

3.1.2 These discussions assist the actuary in understanding:
—   the context in which he is carrying out his work; and
—   trends and other features in the data being analysed.

These discussions help to develop an understanding of the company's insurance operations. They represent an essential part of the information gathering process, and it is useful to ensure that they are fully documented.

3.2 *Discussions with Underwriters*

3.2.1 Key to the discussions with the underwriters is the development of an understanding of changes in the way in which the book of business has been written. The estimation of loss reserves will be based on the available historical information, and the extent to which this could potentially overstate or understate potential future development needs to be assessed.

3.2.2 For example, it may be the case that the business underwritten in recent years is shorter tailed than business written in previous years, i.e. claims will be settled faster. Projections for the recent years, based on assumptions appropriate for the older years, will lead to estimated reserves which are overstated. The statistics, however, may not yet show the shorter-tailed nature of the new business. Discussions with underwriters are likely to bring these changes to the attention of the actuary. These discussions should include the precise reasons as to why the claims development is expected to be different. This assists the actuary in devising appropriate adjustments to development assumptions. A healthy scepticism is, however, useful. It is not unknown for expected changes to claims development to fail to emerge. In this context, it can be useful to consider whether any data exist, or can be compiled, which would support the change in development assumptions, particularly when these could potentially lead to material changes in estimates of loss reserves.

3.2.3 It is often useful to produce schedules of premium income by class of business within each territory before commencing discussions with underwriters. This is particularly the case if the actuary is reviewing the business for the first time and does not have a detailed knowledge of the business. These schedules can be used as an agenda in so far as they provide a list of classes of business which need to be covered. Equally, because the schedules show which are the more significant areas, at least in terms of premium income, they assist in focusing attention on what are likely to be the more material areas. Some care, however, needs to be exercised. Premium income for a particular class of business may be small, but the nature of the business may, however, be such that claims have significant potential to be large. If the schedules of premium income are only available for the most recent underwriting year, then it is important to consider whether there have been changes in the mix of business over time. It may be the case that a class of business is currently small, but was large in the past. Concentration on the amounts of business written in recent years may result in the class of business not receiving its due attention.

3.2.4 It cannot be overemphasised that the actuary must understand the coverage provided. This can be extremely complex. Not fully appreciating these complexities can result in estimates which are materially distorted. The following example is intended to illustrate the point. Table 3.1 shows incurred claims and booked premiums for a particular series of contracts at the evaluation date. Incurred claims are the sum of claims paid and the amounts estimated by claims handlers for known outstanding claims.

Table 3.1. Claims statistics

Underwriting year	Booked premiums	Incurred claims
1988	10.0	0.0
1989	10.0	0.0
1990	10.0	0.0
1991	10.0	0.0
1992	10.0	0.0
Total	50.0	0.0

3.2.5   The statistics show no incurred claims.   Simply applying projection techniques to these claims will not work.   The coverage may be complicated. For example, the insured may retain all claims subject to a large deductible.   It is only when aggregate claims exceed this deductible that the insurer becomes liable to any claim.   It may take some time for aggregate claims to increase to the level at which the insurer becomes involved.   While no claims have yet reached the insurers' level, they may well, however, do so, and to a potentially significant extent.

3.2.6   More importantly, it may be the case that these contracts, which have as yet given rise to no claims, but have significant potential to do so, are included within the statistics for a class of business which superficially does not appear problematic.   Discussion with underwriters is the best, if not the only, way in which to understand these potential difficulties.   An illustration of a possible approach to the above situation is given in Section 5.13.

3.2.7 There are some problematic areas which should be addressed as a matter of course in these discussions, because these areas can require non-standard approaches and data.   These areas include the possibility of any exposure to known market problem contracts or to problem losses, such as asbestos or pollution losses.   The type of business written and the years over which it was written are important warning signals for the actuary.   For example, if there is significant U.S. business written, the actuary should ask about possible exposure to those losses.

3.2.8   The discussions with underwriters should cover descriptions of the geographic mix of business, because the claims development can vary significantly by territory of origin, and because business written in different territories can present different reserving problems.

3.2.9   Rate level indices, which are discussed later, should be requested, although these are seldom available.   If these rate level indices are not available, the history of rate changes and change in terms and conditions should be covered in the discussions.   These rate level indices are useful in setting loss ratio assumptions.

3.2.10 There may be peculiarities of the business written, which can impose limitations on the ability of the actuary to assess required loss reserves or overall

profitability. These include portfolio transfers and clean cut treaties. The liability of the reinsurer in these cases is extinguished, usually after one year, by a payment to the reinsured. Treatment of these claims varies in statistics, and the manner in which they are reflected in the statistics needs to be understood.

3.3 *Discussions with Claims Staff*

3.3.1   The discussions with claims staff can be used to develop an understanding of claims procedures, how reserves are established (including any changes in this area) and any procedural changes, such as backlogs in claims processing. Changes in the types of claims being reported should be covered.

3.3.2 A brief review of claims development, before discussions with claims handling staff, can be helpful, since this review may prompt questions which can be covered in the discussion. A review of a sample of claims files with claims staff is one of the best ways in which the actuary can understand how claims are processed, and the precise nature of these claims.

3.3.3   The actuary will base his estimates on an analysis which includes a review of historic trends. There is a need to understand why these trends may not be repeated in the future. A classic situation is where case estimation procedures were changed. The claims progression will be different after such a change. Figure 3.1 shows two claims development patterns. The vertical axis shows the percentage of claims which have been incurred, and the horizontal axis shows the years since the relevant policies were underwritten.
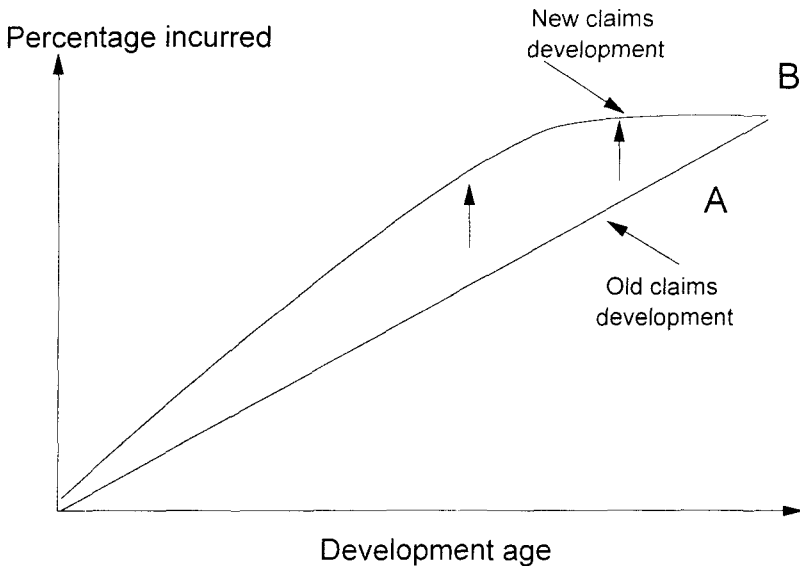

Figure 3.1. Changes in claims development

3.3.4 Line A shows the development of incurred claims that applied when the old claims procedures were in place, and line B shows the development that applies with the new claims procedures. Some of the change in development may be indicated by the statistics. Discussions with claims staff will assist in discovering this change and, in this case, avoiding overestimation of reserves. Mohrman & Agin (1989) distinguish between the implications that such a change has for the claims handling function and the implications that it has for the financials.

3.3.5 The actuary needs to understand the procedures used to establish case reserves and also how payments are booked, which varies across the market. Procedures for handling claims will vary by type of business, and will depend on whether the organisation is a leading or a following underwriter. A leading underwriter will have responsibility for agreeing the brokers' claim presentations, which will include, in the case of liability claims, the relevant attorney's reports. He will, therefore, tend to have more detailed claims information than that available to the following underwriters.

3.3.6 The costs of settling claims include the attorney's costs, and these are usually included in the reserves established by the company. As a consequence, actuarial projections implicitly make provisions for future costs. The basis of reserving for these costs may have changed, and any such changes need to be understood to avoid over or underprojecting.

3.3.7 It can be helpful to ask the claims staff whether they have been recently notified of any changes in the types of claim being presented or any other changes. This question can often prompt invaluable information covering faster processing of certain types of claim because of market agreements, the emergence of a new latent claim type, major market settlements or commutations. Failure to appreciate these new developments can lead to significant distortions to actuarial estimates, either because new claim types are not recognised, or because claims already fully settled are further projected. Equally, the claims staff may have access to models developed, either internally or externally, on the likely progression of particular claim types. These should not be overlooked, and may, in some cases, be directly incorporated into the analysis. Further developments on these may be possible, which is an area in which claims staff and the actuary can profitably work together.

3.4 *Discussions with the Reinsurance Department*

3.4.1 The basic forms of reinsurance are proportional and non-proportional. Proportional reinsurance includes quota share and surplus reinsurance. These often contain profit commission claims, which have varying degrees of importance. In some cases the profit commission adjustment terms are such as to convert the contract from proportional to non-proportional, or indeed make the treaty simply a device to have certain accounting implications, with little or no risk transfer. Non-proportional protections may contain any number of attached conditions which substantially alter the mathematics of any models and vary from

the simple to highly complex. It is useful to have copies of reinsurance flowcharts, if available, before discussing programmes, as these can form a basis for such discussions. Figure 3.2 shows such a simplified flowchart.
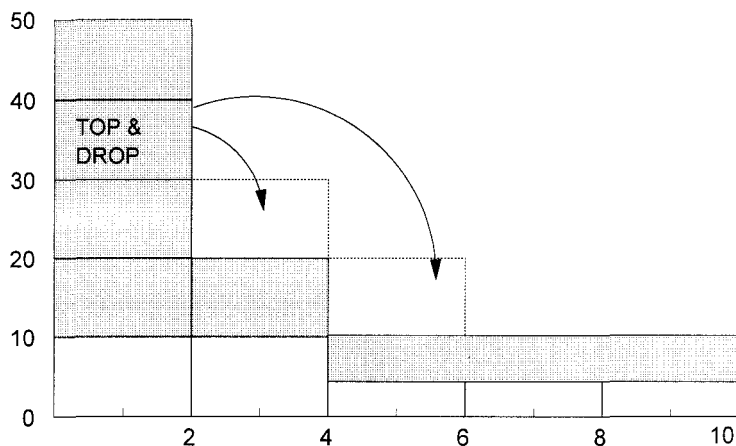

Figure 3.2. Excess of loss programme

3.4.2 The first layer of the programme provides protection of U.S.$10 million excess of U.S.$10 million. There is a front end layer which provides a total protection of U.S.$20 million or the equivalent of two maximum losses. (The front end may be utilised by a larger number of smaller losses.) There is a backup layer which provides a further protection of U.S.$20 million, again the equivalent of two maximum losses.

3.4.3 The layer U.S.$10 million excess of U.S.$30 million is a 'top and drop' layer. It may be utilised either by losses which exceed U.S.$30 million or as a backup layer at the lower levels shown. At which level it is used will depend on the size and number of the losses and the precise wordings of the treaties. The diagram also shows, at the lower right, that there are reinsurance treaties which are excess of aggregate deductibles. These provide protection of U.S.$5 million excess of U.S.$5 million, but subject to an aggregate deductible of U.S.$20 million, the equivalent of 4 losses of U.S.$5 million. There are further complications, for example the reinsurer usually only pays a percentage of the loss to the layer (co-insurance) and receives further premiums as he pays claims (reinstatement premiums). Further complications are dealt with in Czapiewski *et al.* (1993). Discussions with reinsurance staff concerning the day-to-day workings of the programme are one of the best ways to understand the complexities involved.

3.4.4 A particular problem encountered in the London Market is the problem of catastrophe losses, which 'spiral' around the market as claims are successively passed from cedant to reinsurer to reinsurer. The progression of incurred claims

for such a catastrophe might, in its early stage of development, be as illustrated in Figure 3.3.
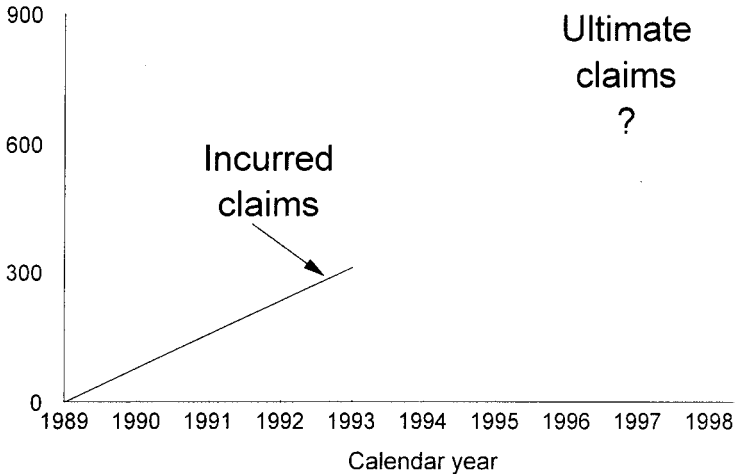

Figure 3.3. Progression of catastrophe incurred claims

The net cost of the catastrophe to the reinsurer will depend on the interaction with the reinsurance programme, and may be substantial if the catastrophe loss exceeds the reinsurance programme.   It is, therefore, important to cover, in discussions with reinsurance staff, the known catastrophes and their size in relation to the reinsurance programme, the historic progression of the incurred amounts and the insured's exposure to the catastrophe. This area is considered further in Section 5.9.

3.4.5   Reinsurance   processing   procedures   have   implications   for   the development of net claims. In some companies a net paid claim is a gross paid claim less any potential reinsurance recoveries. In others a net paid claim is a gross paid claim less any reinsurance recoveries actually received.   In some companies reinsurance recoveries are processed in the statistics as if fully recoverable, even if, because of the failure of some reinsurers, they will not be fully recovered. In other companies reinsurance recoveries are processed based on performing reinsurance security. Indeed, the same company may have used different procedures at different times.

3.4.6. The procedures need to be understood, because, if they have changed, an adjustment may be required. The procedures used in processing recoveries also have implications for what the actuary is actually projecting. For example, if recoveries are processed, in the statistics, as if fully recoverable, even if some of the reinsurers have failed, then the statistical projections of future claims movements also treat all reinsurance as recoverable. If, on the other hand, the reinsurance recoveries are processed based on performing reinsurance security,

then the statistical projections of future claim movements will make some allowance for further non-recoverability, although not necessarily in an appropriate fashion, since future reinsurance failure is then simply based on historic failure to pay claims, and does not consider the current or potential financial strength of the reinsurers.

4. DATA CONSIDERATIONS

4.1 *Introduction*

4.1.1 Data are some of the most important business assets of an insurance company. Better data lead to better control of results. Better data improve the value and use of the reserving function. Better data highlight problems and opportunities sooner.

4.1.2 The company's data will be accessed by different levels of the organisation. There is a clear need for a common understanding of what is compiled, and how. The underwriter, the actuary and the claims handler will have different perspectives, and may have different views on what is important. Failure to have a common understanding leads to confusion and misinterpretation.
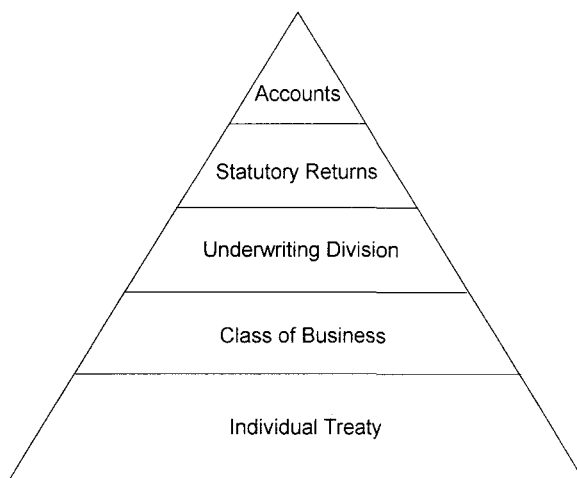

Figure 4.1. Levels of data

4.1.3 Considerable time is often spent getting the data right. This is true regardless of size of the organisation. Data problems are almost inevitable, especially where there is no integration of accounting and underwriting systems. The quality of the data available is often a reflection of the importance historically given to this area.

4.1.4   The quality of the actuary's reserve estimates are fundamentally dependent on the quality of the underlying data. Sophisticated techniques applied to data which are inaccurate, incomplete and badly defined do not produce reliable estimates. It is helpful to liaise closely with the auditor to ensure that statistics, and other data, on which the actuary is relying, are included within the scope of audit.

4.2 *Data Reconciliation*

4.2.1   A reconciliation of data to accounting information should always be carried out. A typical reconciliation consists of the calculation, from the statistics, of a schedule of outstanding claims by class of business as at the evaluation date, and a comparison of this schedule with a similar schedule produced from accounting information, together with a check that the total of the accounting schedule agrees to the accounts, either published accounts or internal management accounts. A similar exercise is typically carried out for incremental claim payments and incremental booked premiums. The exercise is usefully carried out gross of all reinsurance and net of all reinsurance.

4.2.2   Reconciliation of statistical outstanding claims and claim payments accounting information helps ensure that:
— the data are understood;
— the data used are complete;
— the data are accurate; and
— the accounting treatment is understood.

4.2.3   The following is an example of the, often significant, importance of reconciliation (there is no typical example). Some reinsurers, particularly those with continental parents, allocate transactions back to the original cedant transaction date. In this case, part of the claims development is invisible in the triangles, and adjustments are required. The following triangles illustrate the point:

Incurred claims				Incurred claims			
1991	100	150	200	1991	100	150	200	200
1992	100	130		1992	100	150	180
1993	50			1993	100	130

The first triangle is the triangle produced by the company as at 31 December 1993. The second triangle is the triangle produced by the company as at 31 December 1994. Some of the numbers in the body of the triangle have been changed, because the company allocates claims, not to the development age when claims were notified to it, but to the development age when the cedant was notified. Projections based on these data need to incorporate an adjustment for the claims development not evident in the triangles. This adjustment can be material. The need to make this adjustment can be discovered from interviews

with staff or from carrying out a reconciliation exercise (incremental claim payments for any calendar year diagonal will not agree to accounting information), which highlights the importance of both discussions and reconciliation.

4.3 *Data*

4.3.1 The *basic* data required for the estimation of loss reserves consist of triangulations of:
— premiums;
— paid claims; and
— incurred claims.

4.3.2 More detailed information is required for special situations. A general overview of the data for some special situations is given in the next section. Claims triangulations will also be required for all special situations, since these claims will need to be excluded from the triangulations analysed in the more 'normal' fashion. Equally, discussions with underwriters may lead to a request for detailed data on certain contracts, for example.

4.3.3 Typically, premiums in the London Market are net of commissions and overriders, although this is not true elsewhere. Separate triangulations should be produced by major currency, because the development of business originating from different territories can be different. Currency split is, however, only a proxy to geographic split. For example, business denominated in U.S. Dollars may, in fact, originate from other territories, because of the need to receive premium in a 'hard' currency. It is also useful to have data subdivided by currency, to avoid currency distortions. If the triangulations are provided converted to sterling, the basis of conversion should be understood, which is not necessarily a simple matter.

4.3.4 Reinsurance protections are sometimes specific to a class of business, and in these cases net triangulations can be produced by class of business. Often insurers have general protections. The premiums for these protections cannot be allocated, without approximation, to individual classes and, in some cases, the recoveries cannot be allocated to specific classes. In such cases, net triangulations are only available at an aggregate level.

4.3.5 In the case of excess of loss business, individual claims information will be available. Proportional reinsurance information will be limited to aggregate payments and outstandings for the treaty. In some territories information may be even more limited, with claims further being aggregated across all treaties for each cedant. It is, however, normal in the case of this business to provide details of large losses separately.

4.3.6 Data standards and requirements develop over time, and it is not unusual for new data to be identified as a result of the loss reserving exercise. This is described later. This may involve extensive manual compilations from old records. The costs of such an exercise can often seem daunting at first, but are very often significantly outweighed by the benefits derived.

4.3.7 The statistics can be compiled on various bases. The basis on which the statistics have been prepared needs to be understood, because different bases lead to different estimates. For example, 'paid claims' may be amounts actually paid or amounts agreed as paid. Since the actuary estimates reserves for unpaid claims, he needs to ensure that there is an exact match between his definition of reserves for future claim transactions and that used in the company's accounts. If the paid statistics have been prepared on the basis of what has actually been paid, then the actuary's estimate will be an estimate of future cash transactions. If the accounts reflect an amount in respect of agreed payments, then this amount of agreed but not yet paid claims, which has been included implicitly in the actuary's estimate, needs to be deducted from his estimate.

4.3.8 Triangulations are usually prepared on an underwriting year basis or a year of account basis, although there are other variations. In the first case all policies which incept in a given calendar year are grouped together. In the second case all policies which were entered in a given accounting year are grouped together. In the first case projections will allow for all future movements on business incepting prior to the evaluation date. The second projection will allow for future movements on policies accounted at the evaluation date.

4.3.9 Accounting conventions also differ, and these different accounting conventions result in differences in the timing of profit recognition. Actuarial projections often require translation in order to conform to these accounting conventions. An example of this is the case where the company maintains its statistics on an underwriting year basis, but reports on an accident year basis, holding an unearned premium reserve. The actuarial projections of unpaid claims will include allowance for claims yet to occur. This element needs to be removed, for example by applying loss ratios, with an appropriate adjustment, to earned premiums.

5. ANALYSING CLAIMS

5.1 *Introduction*

5.1.1 Appendices 1 to 5 set out the analysis of a fictional London Market account. The case study is intended to illustrate the typical reserving process and to draw attention to the important principles. These are:
—   the process is investigative;
—   understanding the business;
—   understanding the claims development;
—   testing assumptions; and
—   reviewing results for reasonableness.

5.1.2 The following sections describe the general principles of triangulation techniques, pricing analysis and the general approach to modelling special

situations. The case study contained in Appendices 1 to 5 gives an illustration of these approaches in a rather simplified environment. A list of recommended reading for those interested in more detail is given with the References.

5.2 *Segmenting and Aggregating Data*

5.2.1 The structure of the analysis will be determined following discussions with management, underwriters and claims staff. The form of the analysis will depend on the available data and the nature of the business written, and there may be certain losses and contracts which will need separate analysis.

5.2.2 It is typical for writers of London Market business to have many detailed risk classifications. Producing summaries, as at the evaluation date, of premiums and outstanding claims, assists in directing attention to the potentially more significant classes. The account will need to be segmented for the purpose of analysis. This will generally consist of grouping many different risk classifications into the class groupings to be analysed. Segmentation should take into account the different claims development patterns.

5.2.3 There will be the need for some aggregation of the classes. The principles involved are to ensure that there are sufficient data in the different classes to provide meaningful results, while ensuring that classes with different claims features are kept separate. It is useful to have some discussion with other users of the analysis, such as management, who will need to use the projections, and may have views on possible segmentation or aggregation. It is also useful to discuss these groupings with underwriters prior to commencing analysis. This avoids problems later, particularly where the classes, while they have similar features, are underwritten by different individuals.

5.2.4 It is useful to prepare a summary, showing, for each of the class groupings at the level at which they are to be analysed, outstanding claims and estimated reserves. As the analysis proceeds, assumptions will change, data will be disaggregated or further aggregated. The summary can be recalculated periodically in order to monitor the effect on overall estimated reserves of these changes. The importance of this, in practice, cannot be overstated, both for its usefulness as a check and for tracking the effect of changes in assumptions, which is invaluable in building up a mental picture of where uncertainties lie.

5.3 *Triangulation Methods*

5.3.1 The triangulation methods are based on the application of development patterns to the insurer's premiums and claims. The underlying assumption in these methods is that the historic development of the class of business being reviewed is appropriate for future projections. The assumption will require adjustment if there have been changes. (These are not always evident from triangles, which is one reason why discussion is important.)

5.3.2 Essentially, these development patterns are used to move claims data, either paid or incurred, to ultimate, as illustrated in Figure 5.1.
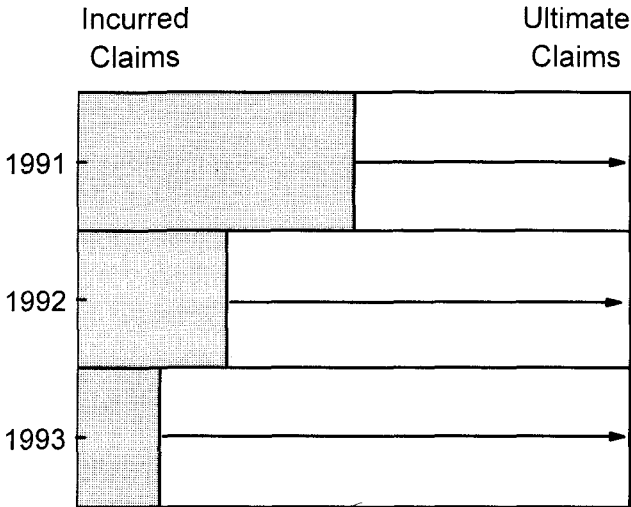
Figure 5.1. Projecting claims to ultimate

5.3.3 The development of the claims, compiled by underwriting year, reflects the time lag between various events.   These are the sale of the policy, the occurrence of the insured event, the notification of the event, the establishment of a reserve, the first payment of a claim and the final settlement. In the case of incurred claims development, the development of claims also reflects the emergence of redundancies or deficiencies in case estimates.   Any changes in these processes will change claims development, which needs, therefore to be understood and appropriate adjustments made.

5.3.4 Projected ultimate claims on an underwriting year basis are the ultimate expected claims costs for the underwriting year in question.   The projections allow for claims which have yet to occur.   The projected claims also include claims which have occurred, but have not been reported, and include an allowance for the redundancy or deficiency of case estimates.

5.3.5 Figure 5.2 shows development patterns for paid and incurred claims taken from the case study in the appendices. The patterns shown are for business written prior to 1986. Different patterns are used for business written after 1985, because the development is expected to be different. The derivation of these patterns and the various assumptions used are set out in Appendix 1.

5.3.6 Development patterns are selected following a review of the data. This review can include the use of statistical packages.   This process involves the identification of unusual claim features, which may lead to further discussions, either with claims staff or with underwriters. These further discussions will cover the possible causes of the unusual claims features, and may lead to further adjustments to assumptions. Automatic projection methods, which do not involve
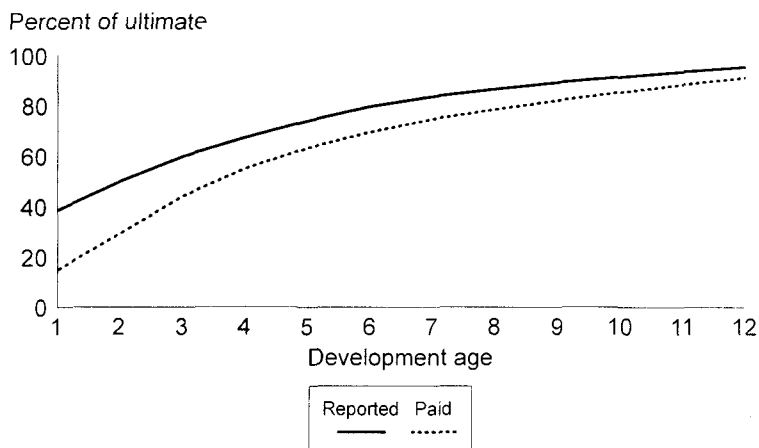
Percent of ultimate

Figure 5.2. Claims development

a detailed review of the development by the actuary, can lead to significant distortions, because of the failure to make these changes.

5.4 *Benchmarks*

5.4.1 Figure 5.2 shows that, after twelve years, which is the age of the oldest underwriting year in the case study, 95% of claims have been incurred (or 'reported') and 91% of claims have been paid. These 'tail factors' are not based directly on the insurer's own claims data. (Strictly speaking, tail factors are the reciprocals of these percentages.)

5.4.2 The best source of information in determining the tail factor is a benchmark. A benchmark is a claim reporting or payment pattern derived from external sources. Curve fitting on internal data may be the only substitute in some cases, but can give very misleading results, and should not be a substitute for benchmarks. It is very easy to understate the length of the tail when, for example, only ten years' data are available for a long-tailed class of business. A long-tailed line of business can still be paying (and indeed reporting) after 30 years, even excluding the effects of pollution and asbestos, and the data after ten years, for example, may not indicate this. Comparison of actual claims development patterns with benchmark development patterns is an extremely useful guide to assessing the potential for future development. Benchmarks should never be applied without testing them. One such test consists of comparisons of the development assumed for the years for which data are available with the development implied by the benchmark development patterns. These comparisons may suggest adjustments which need to be made to the benchmark patterns, prior to application. An example is shown in Table 5.1. The development factors have been calculated in a fashion similar to that used in Appendix 1.

Table 5.1. Comparison of development factors

Development period years	Development factors data	Development factors benchmark
1-2	1.26	1.25
2-3	1.19	1.20
3-4	1.11	1.12
4-5	1.06	1.06
Tail		1.12

5.4.3 In this case the benchmark, selected because it relates to a similar type of business, indicates a tail factor of 1.12, and, given the close agreement with the data, indicates that this might be appropriate for the business being considered.

5.4.4 As already noted, much of the business is spread around the market, and development patterns derived from analysis of insurers with a longer history can be extremely useful in producing benchmarks. The data may be available because of participation, via reinsurances or the writing of the business, in another part of the group. Useful benchmarks can be compiled from data available from Reinsurance Association of America, London Insurance and Reinsurance Market Association, the Insurance Services Office, or A.M. Best's.

5.5 *Premium Projections*

Premiums also develop over time, and therefore require projections. These projections allow for broker delays, processing delays and adjustments to premiums, for various reasons. These projections are carried out in order to
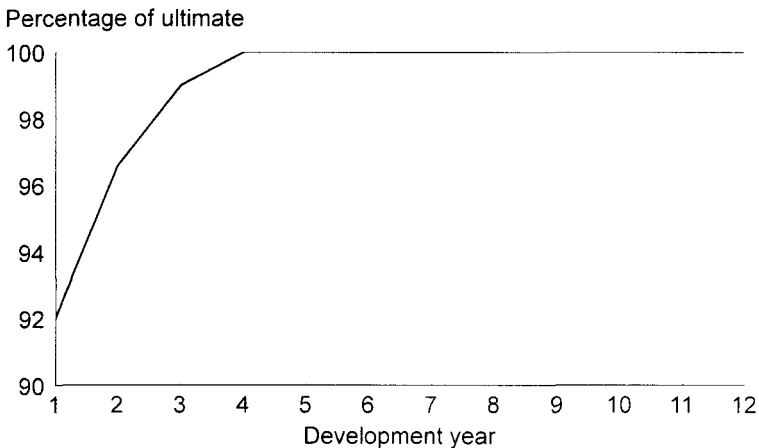
Figure 5.3. Premium development

enable credit to be taken for future premiums on business already written. It is also often necessary for the exposure based approaches to be carried out, as described in Section 5.8. The premium development pattern shown in Figure 5.3 is taken from Appendix 3. In some cases models which are more detailed than the model shown in Appendix 3 are required. An example is the projection of ultimate premiums for a heavily reinsured book of catastrophe reinsurance. Premium development on such a book depends on claims development, and a model which captures this interaction may be required.

5.6 *Claims Handling*

Claims handling expenses can be classified into allocated loss adjustment expenses (ALAE) and unallocated loss adjustment expenses (ULAE). The first type is normally included within claims triangulations, and is therefore implicitly included in the actuarial projections. The second type is almost invariably not included in the statistics, and a reserve for this liability is required. Johnson (1989) covers this area in detail.

5.7 *Analysing Rate and Other Changes*

5.7.1 It is a common misconception that the only information of any value for claims projections is claims information. Claims information may, however, be of little value for recent underwriting years. Figure 5.4 shows a possible reporting pattern for a long-tailed class of business. Ultimate claims for recent underwriting years, which are based on development percentages, will be very sensitive to small changes in paid or incurred claims.

Figure 5.4. Claim development patterns

5.7.2 Figure 5.4 illustrates that, for example, less than 30% of ultimate claims are expected to have been reported by the end of the third development age. It is only after twenty five years that almost all claims are reported.

5.7.3 Reserve estimates for recent years for long-tailed lines of business need, therefore, to be based on other information, and these estimates need to be modi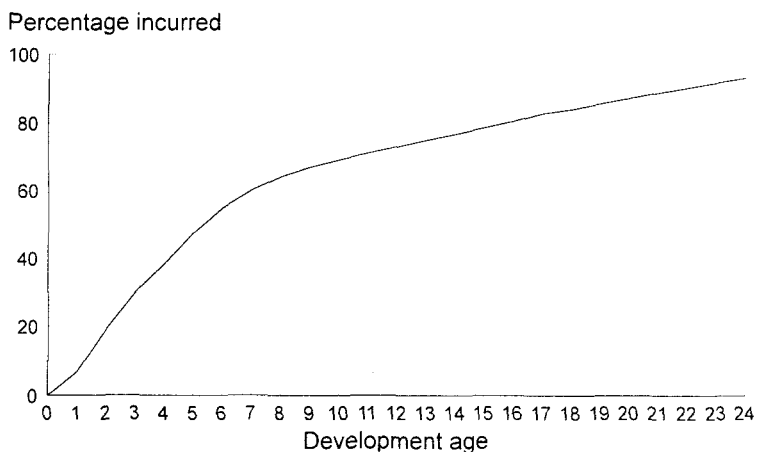fied over time, as necessary, as claims actually emerge. The principles involved in the projection of ultimate claims, based on an analysis of rate and other changes, are to use a measure of exposure to estimate ultimate claims as a rate per exposure, and to then make allowance for changes in rates, exposure, limits and claim size distribution. In practice, good exposure measures are not available and premium income is used as a proxy, although this should not distract from attempts to find better measures, e.g. tonnage in the case of a marine account, or fee income in the case of a professional indemnity account. Estimation of rate changes are based on analyses of factors such as attachment points (or deductibles), limits, signed lines and the use of appropriate loss distributions.

5.7.4 Appendix 4 contains an example which provides an illustration of some of the practical details. The results of these projections are shown in Table 5.2.

Table 5.2. Summary of direct casualty projected ultimate claims

Underwriting year	Initial expected loss ratio method (1)	Incurred Bornhuetter Ferguson method (2)	Paid Bornhuetter Ferguson method (3)
1982	103	103	103
1983	115	117	119
1984	116	119	117
1985	129	135	127
1986	149	147	153
1987	149	154	147
1988	169	174	167
1989	194	198	198
1990	232	245	238
1991	230	238	235
1992	260	266	269
1993	275	281	278
	2,121	2,177	2,151

5.7.5 The initial expected loss ratios are derived in Appendix 4, which also sets out the calculation of the results of the Bornhuetter Ferguson method, from an index which considers:

— rate changes;
— layer changes; and
— coverage changes.

5.7.6 The process of analysing rate and other changes aggregates the various rating decisions made by underwriters in the course of the year. Some of these cannot, in practice, be readily quantified, and, in such cases, subjective opinions on the improvement or deterioration in loss ratios may need to be incorporated.

5.8 *Using Different Projection Methods*

5.8.1 Different claim projections should always be used. For example, paid and incurred claims should be projected separately and the results compared. The point of using different methods is not to have identical or similar estimates produced by different methods, but to have the added insight that comes from looking at different data which behave in different ways, and comparing the answers. The fact that different methods give different answers provides much useful information to the actuary. Indeed, the differences between results of the various methods can often be more interesting than the similarities.

5.8.2 Table 5.3 shows the results of projecting paid and incurred claims. These results are taken from Appendices 1 and 4. The results of these projections are in close agreement.

Table 5.3. Summary of direct casualty projected ultimate claims

Underwriting year	Projected incurred claims (1)	Projected paid claims (2)	Initial expected loss ratio method (3)	Incurred Bornhuetter Ferguson method (4)	Paid Bornhuetter Ferguson method (5)
1982	104	103	103	103	103
1983	117	119	115	117	119
1984	118	117	116	119	117
1985	137	127	129	135	127
1986	148	154	149	147	153
1987	155	146	149	154	147
1988	175	167	169	174	167
1989	200	200	194	198	198
1990	250	241	232	245	238
1991	242	239	230	238	235
1992	270	284	260	266	269
1993	286	285	275	281	278
	2,200	2,182	2,121	2,177	2,151

5.8.3 In practice, this degree of agreement seldom exists. Indeed, the data on which the projections are, in practice, based would be considerably more erratic than that on which these projections have been based. Some of the differences (by underwriting year) between the results would, in practice, again necessitate further research, which generally improves the actuary's understanding of the business, and assists the actuary in determining which of the various projections of ultimate claims is likely to provide the best estimate.

5.8.4   Different methods have been used to project claims to ultimates. Each of these methods typically gives different estimates of ultimate claims for the same class, and the estimate needs to be selected from the different projections available.   The selection of an estimate or an average of various estimates is judgemental, and reflects, amongst others:
—   possible distortions in different methods;
—   reliability of different methods for different years; and
—   stability of the data used in each method.

5.9 *Analysis of Outwards Reinsurance*

5.9.1   Outwards   reinsurance   programmes   vary   from   the   relatively straightforward to the highly complex. The recoverability of a claim under some of the more complex programmes is dependent on a large number of factors, including the sizes of other claims, changes in exchange rates, date of settlement, date of loss, interactions because of warranties and exhaustion, or otherwise, of higher layers. It is always important to extract the major claims and to analyse these separately, in order to allow for these factors to the extent possible and to assess the potential that these claims may have to exceed reinsurance programmes.

5.9.2 An approach which is generally suitable for the non-major claims is to review triangulations of ratios of net incurred claims to gross incurred claims and triangulations of net paid claims to gross paid claims. This review can be used to derive ultimate net to gross ratios, using development assumptions derived from these triangulations. Analysis at this level generally incorporates most of the features of the process. Ratios need to be considered for reasonableness across underwriting year in relation to changes in the reinsurance programmes. Ultimate net claims can then be estimated by applying these ratios to projected gross claims. It is also possible to take other approaches. For example, ratios of net outstanding claims to gross outstanding claims can be reviewed, with selected ratios applied to estimates of gross reserves.   Further approaches are dealt with in Czapiewski *et al.* (1993).

5.9.3   Figure 3.3 shows the incurred claims development of a property catastrophe, which might, for example, be a major hurricane.   The incurred claims have developed strongly and have the potential to continue to develop. The best fit to the progression, shown in Figure 3.3, is clearly a straight line, and the incurred claims, in themselves, do not provide sufficient information to determine, even approximately, the potential ultimate costs.

5.9.4 The implications of some authors appear to be that it is appropriate to base estimates of ultimate claims on an approach which fits curves to claims data. In practice, however, at the earlier stages of development, it is possible to find different curves which agree with the historic data for the catastrophe being reviewed (and fit other older catastrophes equally well), but produce significantly different estimates of ultimates.   Taking an approach which is simply based on curve fitting can produce estimates which give a degree of unwarranted

confidence. Figure 5.5 shows various curves which might be fitted to the data. The curves A, B and C might be based on different formulae, or indeed on the same formula, but using different goodness of fit tests.
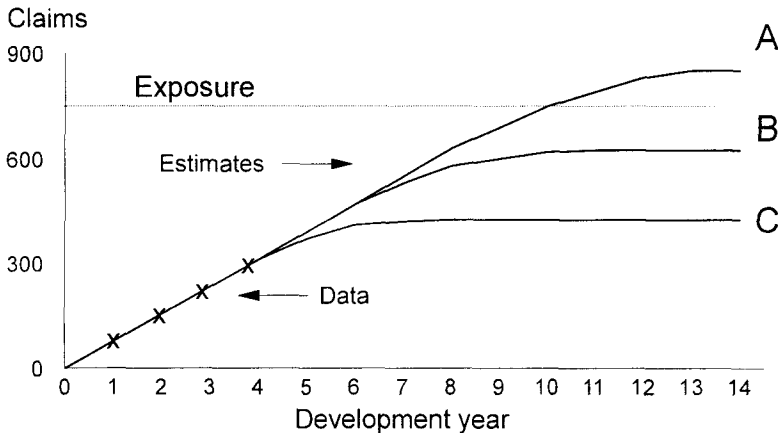
Figure 5.5. Curve fitting to catastrophe claims

5.9.5 Figure 5.5 also shows the estimated total exposure. Curve fitting, of itself, does not involve a detailed review of the underlying exposures, and thus fails to bring this information into the reserving process. Reviewing exposure details by segment of the account enables estimates to be tracked in a way which relates to the business written, rather than simply to changes in parameters.

5.9.6 This approach is essential when catastrophe claims are recent and continuing to develop strongly. It is less important when the catastrophe becomes more mature. The demise of the LMX market and the maturity of many, if not most, of these catastrophes has reduced the importance of these considerations, although the principles are still important. Appendix 5 sets out a possible approach, which considers underlying exposures and produces an estimate of ultimate losses which allows for the policies in force and the types of business covered.

5.10 *Other Techniques*

5.10.1 Triangulation techniques and techniques based on trends in terms and conditions are the basic techniques used. There are a large number of cases where these are not appropriate, for different reasons. In such cases different approaches need to be used. Generally speaking, most companies or syndicates will require special analysis for at least one part of their business. Few, if any, insurers have exposure to all the special situations. The following sections deal with three special situations that might be encountered.

5.10.2 Triangulation techniques are based on the application of claim development patterns to the insurer's claims. These development patterns, which

may vary by underwriting year, are derived partly from the insurer's data and allow for the ageing of its claims. In some cases this approach is not appropriate. The historic development of the class may not be representative of the development of the loss type being considered, there may be no losses to date at the insurer's level, the loss type may be new, or show calendar year rather than development age features. The general approach is to:
— understand the problem;
— consider the data availability; and
— devise and apply a solution.

Appendix A.2 gives a case study illustration of some of the features of the process. Each of these situations presents unique problems which require unique solutions.

5.10.3   In cases where special treatment is required, the claims and, where appropriate, the premiums, need to be extracted from the triangles of the relevant classes. Extracting these claims is almost certainly essential, even if the amounts involved are small, since their inclusion can significantly distort any development patterns applied to recent years. The following sections give an overview of the approach in some areas. These sections are not intended to be complete, and, indeed, some of the situations which are met with in practice merit a paper in their own right. These sections are intended to illustrate the different problems encountered and to provide outlines of the different solutions devised and data required.

5.10.4   Devising solutions often requires research into the claims environment, including understanding the legal environment, academic studies on medical conditions and coverage issues. In some of these cases the solutions involve the use of the triangulation methods described above applied to different data. This may include compiling substantial amounts of new data, including details of claims counts. The following sections describe three situations which may serve to illustrate the approach. The three situations covered are:
— asbestos on direct insurance;
— Lloyd's stop loss contracts; and
— contracts with underlying deductibles.

5.11 *Asbestos on Direct Insurance*

5.11.1   Asbestos claims generally arise for products liability claims, although there are some third party claims, particularly related to railroads. The normal triangulation techniques are inappropriate for a number of reasons. Projections using triangulations by underwriting year are based on the assumption that the claim emergence is dependent on development age. While there is some development age dependency in the case of asbestos claims, much of the development is calendar year dependent. For example, incurred claims across all underwriting years may be affected by judicial decisions made in a particular

calendar year, or may be affected by a change, in a particular calendar year, of the method of allocation of claims by year. The emergence of an insured as a new source of claims will affect all or most of the underwriting years for which coverage was provided, and will be evident as calendar year dependent.

5.11.2 The analysis of these claims requires an understanding of the potential for new claimants to emerge and the basis on which claims are allocated to policies, either because of aggregation of claims, or because of allocation of claims by year. The analysis also requires the compilation of policy details. These data include details of policy limits, attachment points, the insurer's line on the policy and details of aggregate limits.

5.11.3 A number of studies have been carried out in the U.S.A., which use generally accepted approaches to project ultimate numbers of asbestos claimants. Application of the results of these projections to assumed average claimant costs, allowing for future claims inflation and expenses, adjusting for propensity to claim, can be used to derive estimates of ultimate claims by groups of insureds. The results of this exercise can then be applied to the layers written by the insurer, having considered allocation by year and also exclusions. The approach makes allowance for many features of the process which would not be captured by triangulation methods, including allowance for future claims related to insureds who have not yet notified claims to the high layers written, or, conversely, the limiting effect of policy limits. Cross & Doucette (1994) provides an excellent description of approaches to the measurement of liabilities in respect of these claims.

5.12 *Lloyd's Stop Loss*

5.12.1 In the case of Lloyd's stop loss contracts, policies were written on lineslips. These policies were sold to Names and provided stop loss protection. If the Name's losses for a given underwriting year exceeded an amount ('the deductible'), the policy met the losses in excess of this amount up to a limit ('the policy limit'). The policy is exposed until the underwriting year in question has been closed, in other words until a final result has been declared. In the case of many syndicates on the 1989 year, for example, final losses have not yet been declared.

5.12.2 The data required are the deductible and the policy limit for each Name, together with the insurer's share of the policy. The Name's premium income for each syndicate is also required. Finally, for each syndicate, the declared profit or loss, and whether or not this is final, together with the held reserves are required. The current loss to the insurer can be established in a relatively straightforward fashion, by estimating each Name's share of the result for each syndicate on which the Name participated, and by then applying the deductible and the policy limit. This may not, however, be the final loss if the year of account has not been closed. If reserves on an open year deteriorate, the loss to the insurer will deteriorate. Reserves may deteriorate because the syndicates' reserves estimation process is inadequate, because of the type of

business involved, for example pollution, (for which estimation is difficult) because of the emergence of new claim types, or because reserves were established on an optimistic basis.

5.12.3   Syndicates can be categorised into various groupings, for example LMX, pollution exposure, etc. For each category different reserve deterioration percentages can be applied. The resulting variations at the insurers' level will depend on the number of open years, their distribution by Name, the extent to which policy limits have been reached or deductibles exceeded. A final selection must be made, based on the outcome of these variations.

5.13   *Aggregate Deductibles*

5.13.1   There are a large number of contracts written in the market which provide coverage excess of underlying deductibles, as for example illustrated in Figure 5.6 or considered in Table 3.1. The insureds, in such cases, retain the first parts of losses for each year. Often, in such cases, there is a long time lag before the insurer is notified of claims or books outstanding claims to the layer, or makes a claim payment. Triangulation methods applied to claims at the insurer's level often do not provide reasonable estimates in such situations, and these contracts, therefore, need to be extracted from triangulations and modelled separately.
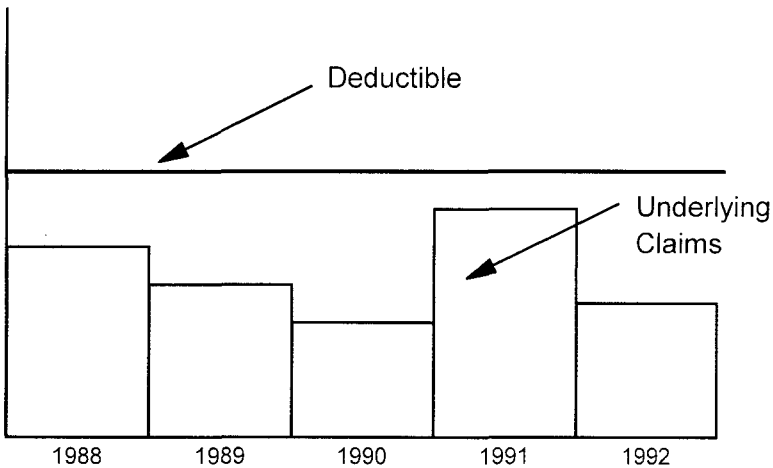
Figure 5.6. Schematic diagram of coverage

5.13.2   The first step in these situations is to understand the policy structures and to programme the process by which these policies respond to losses. The second step is to compile details of underlying claims data. These will include paid and incurred claims data for each policy year at the ground up level. This is not information at the insurers' level, and may involve extensive work in

compilation. Depending on the type of policy, claims count data and exposure measures may be available. Details of claim size distribution are often also required, but may be difficult to obtain. The projection of claims to the insurer's level can be carried out by projecting the 'ground up experience', using the triangulation techniques described above. It may be necessary to consider stochastic variations in order to reflect the fact that only excess claims are payable by the insurer. The insurer's claims can then be estimated by applying policy limits and deductibles. Often, much of the work, in practice, is spent on understanding the policy structure, developing the model and collecting the additional data.

6. DOCUMENTATION

6.1 *Documentation and Presentation*

6.1.1 The documentation of the loss reserving process is often informal in practice. There is value in formalising this process. The results of the process involve an investigation into many areas, past and present, of the company's business.

6.1.2 The investigation may well, typically, involve extensive numerical calculations, and the actuary will have developed an understanding of the account which is, for his purposes, easily presented in numerical terms. The presentation of the results of the investigation in a manner which allows these results to be most easily communicated often requires as much thought as the detailed analysis.

6.1.3 It is worth bearing in mind that perspectives within a company differ. A company which, from an underwriting perspective, is mainly a writer of short-tailed property business may, from a balance sheet perspective, be mainly a liability account writer because of different tails and underwriting changes. A company will often have been in existence for longer than the employment of the oldest staff member. Equally, current staff members may have a clearer picture of the recent, rather than the older years, of the company's operations. Documenting the results across years of operation assists in providing management with a better overall perspective of the company and its historic operations. It also avoids the situation where resources are concentrated in an area which is a known market problem, to which the company has exposure, but, because of the nature of its historic writings, is dwarfed by problems in another area.

6.1.4 The documentation should include a history of the underwriting of the account and claims developments separately by class of business analysed. The assumptions used and their numerical derivation, together with support for the selection of ultimate losses, should be documented to assist in discussions with underwriters and management. Formal documentation facilitates the preparation of management reports as papers, with more detailed support for the more problematic or commercially significant areas. Adopting a formal approach is

also invaluable in ensuring continuity over time and avoiding the loss of valuable information or insights, because of staff changes.

6.1.5 The formal documentation also enables underwriters to correct possible misunderstandings by the actuary. By reviewing results, it indicates areas where these may be possibly understated or overstated and again require further investigation before finalisation.

6.1.6 Suitably documented, the actuarial report is a valuable reference document. It can be used during the year as part of various decision-making processes or to address various questions. Examples of the latter include the possible significance of a deterioration in an area of the account, or the likely effect of certain underwriting changes.

6.1.7 Reserve estimates should be shown by class and by underwriting year. This level of detail is valuable. The distribution of reserves by year assists in understanding overall uncertainties. A company which has expanded rapidly in recent years will have a greater concentration of unpaid liabilities in immature underwriting years, and, therefore, greater potential volatility than a more slowly growing company with the same overall reserves. Examination of reserves by underwriting year may indicate substantial concentration of total reserves in one year of one class. In such cases, efforts can be productively used in analysing the content of that year's business, using individual treaty triangulations and other information.

7. IMPLICATIONS FOR THE BALANCE SHEET AND FOR RATING

7.1 Table 7.1 shows the calculation of the reserve for the direct casualty class dealt with in the case study. This illustration is intended to show the items which are considered in the calculation of the reserve. The essential reserve of 949 is a point estimate. It is uncertain, and ultimate outcomes will differ from those

Table 7.1. Direct casualty calculation of reserves

	Excluding latent claims	Latent claims	Total
Ultimate claims	2,177	251	2,428
Paid claims	1,422	22	1,444
Claims reserve	755	229	984
Ultimate premiums	2,076		2,076
Booked premiums	2,041		2,041
Premium credit	35		35
Reserve	720		949

underlying this estimate. The following sections discuss some of the features of the estimation process which are important from the loss reserving perspective. These features are, of necessity in a paper of this length, dealt with in outline only.

7.2 *Uncertainty*

7.2.1 Uncertainty arises from a number of sources. These sources of uncertainty include, but are not limited to, unpredictability of trends (the data may indicate trends which are not real or may fail to indicate underlying trends), the inadequacy of the data, changes in mix of business (leading to possible changes in development patterns which are difficult to quantify), the development age of the business (reserves for business of recent origin are uncertain, because the claims history is more limited) and the potential for the emergence of new claims types (for example the asbestos or pollution problems of the future) about which nothing is currently known. Estimated reserves are also uncertain because of stochastic variations, although this is generally outweighed by the other sources of uncertainty. Russo & Schoemaker (1992) provide useful insights into uncertainty in the business environment.

7.2.2 The estimation process is not exact, and there are variations around the actuary's estimates which he will consider reasonable. Booked reserves may be higher or lower than the actuary's estimate and still be reasonable provisions. The range around his estimates, which the actuary would consider reasonable, is not a range which encompasses all possibilities, which would be extremely wide. Rather, it is the range which reflects the fact that another actuary in the same situation would have produced estimates which are not the same, but are indistinguishable, given the uncertainty. The accepted variations may be different for different types of business. While estimating reserves should not necessarily be a part of a process of smoothing declared results, management will be sensitive to the effect on declared profits.

7.3 *Monitoring*

7.3.1 Understanding uncertainty assists management in determining whether a class of business should be written. If results are so difficult to assess that balance sheet reserves are subject to wide fluctuations, then this needs to be considered when making the decision to write the business. Following the movement in reserve estimates over time helps in understanding the uncertainties in the process, and can be used to check and improve assumptions underlying projections. Monitoring also highlights areas where further research is necessary, because it identifies areas where reserves are volatile or deteriorating.

7.3.2 Monitoring schedules can be used to highlight areas where there are potential problems, and enable these areas to be researched at an early stage. A possible comparison of estimates is shown in Table 7.2. The estimates evaluated as at 31 December 1993 relate to the underwriting years 1992 and prior. The

estimates evaluated as at 31 December 1992 have been restated to 31 December 1993 exchange rates.

Table 7.2. Comparison of estimates

	Estimated ultimate claims 31/12/92	Estimated ultimate claims 31/12/93	Increase/ (decrease)
Class 1	2,281	2,428	147
Class 2	852	824	(28)
Class 3	750	723	(27)
Total	3,883	3,975	92

7.3.3 The actuary is attempting to estimate provisions for unpaid claims at the evaluation date, based on available data and current knowledge. Estimates may change over time because of changes in data, knowledge, legal and social climate, judicial decisions and because of the emergence of new claims types. It is important that management are aware of these features of the reserving process, and do not read into the numbers a certainty which they do not have, and in most cases cannot have. Much of this uncertainty, particularly in the London Market, arises because of the nature of the business.

7.4 *Investment Income*

7.4.1 It is common in the London Market to make no explicit allowance for investment income in the reserve. Future investment income is often used as an implicit margin for either or both of future claims handling expenses or contingency. The implicit margin may also be used to offset possible underreserving in other areas.

7.4.2 Discounting of reserves, for the time value of money, has been used by some companies who would otherwise have faced intolerable new business strain. Undiscounted reserves can contain substantial margins, although such margins are highest for the longer-tailed accounts where they are often most required, because the reserves for such business tend to be the most variable.

7.5 *Implications of Outwards Reinsurance*

7.5.1 The area of outwards reinsurance has special importance for the balance sheet and for uncertainty. It is an area in which the company's financial security is dependent on that of other companies, and the provision for non-performing security can be an important balance sheet item.

7.5.2 The following example, shown in Table 7.3, illustrates the potential importance of this item.

Table 7.3. Comparison of two balance sheets

	Company A	Company B
Gross claims reserve	1,000	*100*
Reinsurance recoveries	900	-
Net claims reserve	100	100

7.5.3 The balance sheet of Company A is dependent on the balance sheet strength of its reinsurers. Company A has balance sheet exposures which Company B does not have. The failure of reinsurers responsible for 10% of gross claims would lead to a 90% increase in the claims reserves of Company A. Equally, a 10% increase in estimates of gross reserves, with no change in estimated recoveries, would lead to a 100% increase in net reserves.

7.6 *Implications for Rating*

7.6.1 The view that the underwriter will take of the likely profitability of the business is the result of, amongst other factors, the very many individual underwriting decisions taken during the underwriting year. The actuary, in his analysis, has viewed the class of business at an aggregate level, collating these decisions and comparing these with the emerging claims development. The analysis of loss reserves has implications for rating. Indeed, it is impossible to rate unless you have estimated reserves on historic business. Figure 7.1 summarises the results of the analysis for one of the classes considered in the case study, and illustrates some of the implications that the analysis has for the ongoing business.
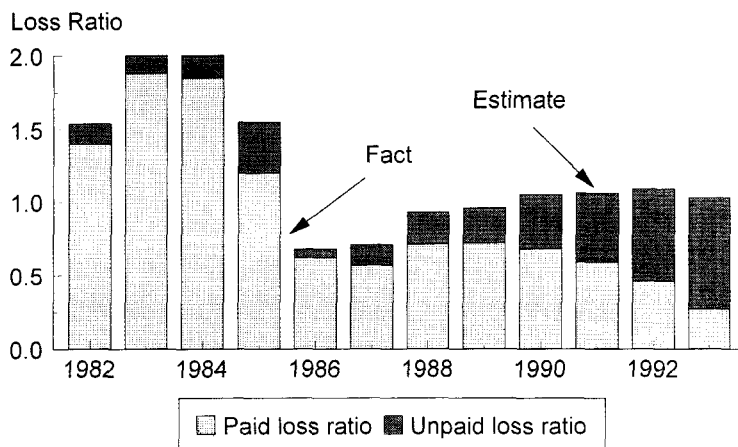

Figure 7.1. Projected loss ratios

7.6.2 Figure 7.1 shows projected loss ratios for the direct casualty class of business, excluding latent claims, which is described in Appendix 1. These loss ratios are calculated as ultimate claims divided by ultimate premiums. They allow for allocated claims expenses, since these are included in the claims data and for commission and brokerage, since the premiums are net of these amounts. They do not, however, allow for other expenses, and do not allow for investment income. These loss ratios, therefore, only provide a partial measure of profitability, but do provide a measure of relative profitability, over time. However, some of the information necessary to estimate the potential credit for investment income is produced as a by-product of the loss reserving exercise. Appendix 1 sets out, for example, the claim payment patterns which could be used as a basis for estimating the credit for future investment income. These loss ratios will be re-evaluated for each of the succeeding loss reserve evaluations. A by-product of the loss reserving exercise, therefore, is the re-evaluation and restatement of historic profitability.

7.6.3 In the period from 1982 until 1984, the loss ratios substantially exceed 100%. The years 1985 and 1986 saw dramatic improvements and, although loss ratios are projected to have increased in the subsequent years, the projections indicate that the business has been profitable, if some allowance is made for investment income. This is an important conclusion from the underwriting perspective. Conclusions for other classes of business might be different, and result in decisions to seek rate increases or reductions in volumes of business.

7.6.4 A significant component of most of the loss ratios shown in Figure 7.1 is based on estimates. Figure 7.1 shows paid loss ratios as well as ultimate loss ratios, and this provides a measure of the extent to which the ultimate loss ratios are dependent on the loss reserve estimation process. For example, ultimate loss ratios for the 1982 underwriting year are only marginally higher than paid loss ratios, and depend only marginally on the estimation process. The estimated profitability, or otherwise, of the more recent years' business is still significantly dependent on the loss reserving process.

7.6.5 The derivation of profitability, in terms of projected loss ratios by class across recent underwriting years, helps identify those classes which have contributed to the company's success and those classes which have been subsidised. The extent of these contributions is a factor in the determination of overall required rate increases and the cost of, for example, remaining in an area of business or writing in a particular territory for strategic reasons. These decisions are difficult, because the base information on which they are made is heavily dependent on estimates for some time. These decisions are also difficult, because they are made in a competitive market where other insurers will have different considerations and may not have the same information available to them, leading to their offering rates which are inadequate, the inadequacy of which does not emerge for some time.

7.6.6 The progression of ultimate loss ratios, shown in Figure 7.1, is typical of the progression seen for many writers of U.S. direct or excess casualty

business written in London. Many other parts of the market have, in different years, experienced loss ratios at the level shown for underwriting years 1982 to 1985 in Figure 7.1. Subsequent years have seen improvements in loss ratios, as the claims on older years' business emerged and the market reacted.

7.6.7 Carrying out the loss reserving process to the best extent possible may lead the insurer to recognise, despite the uncertainty in the process, that the business is being written at unprofitable rates. If the insurer's competitors do not review loss reserves to the same extent, they may continue to write at rates which ultimately prove unprofitable. Continuing to write in such an environment is an important and difficult management decision. The structure of the market is such that these decisions are often left to the underwriter, presenting him with the conflict between writing business and making profits.

8. CONCLUSIONS

8.1 The area of loss reserving is an important part of the work of the general insurance actuary. Most, if not all, general insurance actuaries are involved in this area, either directly for year-end balance sheet purposes, or indirectly in the rating and pricing of business. The sound estimation of loss reserves is essential to the proper management of the non-life insurer, because of its use in determining the most important components of the balance sheet, and because of the perspective it gives to the ongoing profitability of the business. It is not simply a series of numerical calculations, but an overall annual investigation of the insurer's business relying as much on qualitative as on quantitative information.

8.2 The first and most important part of loss reserving is to understand the business. This business is complex, and never stays the same. Understanding the business requires discussions with underwriters, claims staff and reinsurance staff, and relating the indications from these discussions to the indications from the data.

8.3 The quality of the actuary's estimates are dependent on the quality of the underlying data, which, because of its importance, needs to be tested and generally subject to audit.

8.4 The derivation of development patterns may depend as much on external sources as on the insurer's own data. Establishing tail factors, based on a trending of the available claims history of the insurer, without an examination of external sources or considering other data, can be dangerous.

8.5 Many of the reserving problems faced in the market require unique solutions. These solutions require detailed research into the underlying problems and the construction of new models. Devising these models often presents intellectual challenges, and constructing an appropriate approach can be difficult, but when successful, satisfying.

ACKNOWLEDGEMENTS

REFERENCES

Some of the items listed here are referred to in the paper, and others are recommended reading for those who want to consider the subject in greater detail.

ABBOTT, W.M., CLARKE, T.G. & TREEN, W.R. (1981). Some financial aspects of a general insurance company. *J.I.A.* **108**, 119-209.

BENJAMIN, S. & EAGLES, L.M. (1986). Reserves in Lloyd's and the London Market. *J.I.A.* **113**, 197-238.

BORNHUETTER, R.L. & FERGUSON, R.E. (1972). The actuary and IBNR. *Proceedings of the Casualty Actuarial Society*, **49**, 181-195.

CARTER, R.L. & FALUSH, P. (1994). *The London insurance market: issues and responses.*

CROSS, S.L. & DOUCETTE, J.P. (1994). Measurement of asbestos bodily injury liabilities. *Casualty Actuarial Society*, 1994 CLRS Call Paper Program, 162-258.

CRAIGHEAD, D.H. (1994). Reserving for catastrophe reinsurance. *J.I.A.* **121**, 135-160.

CRAIGHEAD, D.H. (1986). Techniques of reserving - the London Market. *J.I.A.* **113**, 411-457.

CZAPIEWSKI, C.J.W., ARCHER-LOCK, P., CLARK, P., CRESSWELL, C., HINDLEY, D. & SHEPLEY, S. (1993). Reserving for outwards reinsurance. *General Insurance Study Group*, **2**, 439-485.

DAYKIN, C.D. & HEWITSON, T.W. (1985). How useful is the chain ladder method for testing reserve adequacy? *G.I.R.O.* **39**, 7.

DAYKIN, C.D. & HEY, G.B. (1990). Managing uncertainty in a general insurance company. *J.I.A.* **117**, 173-259.

JOHNSON, W. (1989). Determination of outstanding liabilities for unallocated loss adjustment expenses. *Proceedings of the Casualty Actuarial Society*, **76**, 111-125.

LONDON MARKET ACTUARIES GROUP (1989). Monograph.

MAHER, G.P.M., RYAN, J.P. & SAMSON, P. (1991). Actuarial aspects of claims reserving in the London Market. *C. Actuarial Society Papers 1991*, 'International topics: global insurance pricing, reserving and coverage issues'. 387-443.

MOHRMAN, D.F. & AGIN, G.A. (1989). Don't blame claims. *Emphasis* **1989/4**, 10-13.

RENSHAW, A.E. (1989). Chain ladder and interactive modelling (claims reserving and GLIM). *J.I.A.* **116**, 559-587.

RUOHONEN, M. (1988). The claims occurrence process and the IBNR problem. *Transactions of the 23rd International Congress of Actuaries*, 113-123.

RUSSO, J.E. & SCHOEMAKER P.J.H. (1992). Managing overconfidence. *Sloan Management Review.* **Winter 1992**, 7-17.

VERRALL, R.J. (1991). Chain ladder and maximum likelihood. *J.I.A.* **118**, 489-499.

WISER, R.F. (1989). Loss reserving. *Foundations of Casualty Actuarial Science*, 143-230. Casualty Actuarial Society.

WRIGHT, T.S. (1990). A stochastic method for claims reserving in general insurance. *J.I.A.* **117**, 677-731.

APPENDIX 1

A CASE STUDY

A.1.1   This case study is based on a hypothetical writer of business in the London Market, whose account is being reviewed, for the first time, by an actuary.   Business was written starting in 1982, and includes liability and property exposure. The insurer has a sophisticated database, and has captured a considerable quantity of information on policies written and claims reported and settled. This information is used by the various departments in the company, although not to the fullest extent possible.

A.1.2   The basic information initially provided for the actuary consisted of triangulations of paid and incurred claims, subdivided by detailed class codes and underwriting year. In total, 100 different class codes have been set up by the company. Some of these were never used by the company, others were used to differentiate between sources of business, and in yet others little business was written. After some discussion on the contents of the various classes, and having reviewed the volumes of business written, it was decided to amalgamate these into 30 different classes.

A.1.3   Table A.1.1 summarises the data available. Separate tabulations were maintained for the different currencies in which the business was written, namely U.S. Dollar, Canadian Dollar and Sterling. Only the U.S. Dollar account, which contained almost all of the business written, is shown here. The paid claims amounts shown for each class are calculated as the sum of the last diagonal of the paid claims triangle, across all underwriting years. The incurred claim amounts are calculated similarly. These represent cumulative amounts to-date. Statistical outstanding claims are calculated as incurred less paid. These are as at 31 December 1993. The accounted outstanding are the amounts which are to be booked in the balance sheet as at that date.

A.1.4 The difference between the statistical and accounting outstanding claims in the U.S. Direct Casualty class relates to a claim outstanding at 31 December 1993, which was incorrectly recorded in the statistics. These errors were then corrected. It is clear from the schedule that the most significant class appears to be the U.S. Direct Casualty class group. As the analyses proceed, the schedule will be updated to include estimated claims and premium IBNR, and changes will be monitored. This Appendix describes the projection of paid and incurred claims for the U.S. Direct Casualty class. The triangle of historic claims is shown in Table A.1.2.

Table A.1.1. Summary schedule

Class	Paid (1)	Incurred (2)	Statistical outstanding (3)	Accounting outstanding (4)	Difference (5)
Liability					
Direct casualty	1,446	1,798	352	372	24
Direct errors & omissions	256	532	276	276	-
Treaty - proportional	169	287	118	119	-
Treaty - non proportional	59	72	13	13	-
Sub total	1,930	2,689	759	780	24
Property					
Direct	40	59	19	19	-
Treaty - proportional	105	210	105	105	-
Treaty - non proportional	115	296	181	181	-
Sub total	260	565	305	305	-
Miscellaneous	124	137	13	13	-
Total	2,314	3,391	1,077	1,098	24

Table A.1.2. Incurred claims

Underwriting year	1	2	3	4	5	6	7	8	9	10	11	12
1982	38	52	62	70	78	84	89	93	97	102	106	111
1983	43	59	70	82	91	98	105	113	118	128	135	
1984	46	59	74	84	93	101	110	116	128	142		
1985	51	70	84	96	106	115	122	128	137			
1986	78	93	106	117	127	134	139	147				
1987	82	95	108	119	128	134	139					
1988	90	107	123	135	145	152						
1989	99	122	139	153	165							
1990	129	154	175	192								
1991	120	147	169									
1992	138	164										
1993	145											

A.1.5 Report to report factors were calculated by dividing cumulative incurred claims at successive evaluation points.

Table A.1.3. Incurred claim development factors

Underwriting year	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
1982	1.368	1.192	1.129	1.114	1.077	1.060	1.045	1.043	1.052	1.039	1.047
1983	1.372	1.186	1.171	1.110	1.077	1.071	1.076	1.044	1.085	1.055	
1984	1.283	1.254	1.135	1.107	1.086	1.089	1.055	1.103	1.109		
1985	1.373	1.200	1.143	1.104	1.085	1.061	1.049	1.070			
1986	1.192	1.140	1.104	1.085	1.055	1.037	1.058				
1987	1.159	1.137	1.102	1.076	1.047	1.037					
1988	1.189	1.150	1.098	1.074	1.048						
1989	1.232	1.139	1.101	1.078							
1990	1.194	1.136	1.097								
1991	1.225	1.150									
1992	1.188										

A.1.6 It is clear from the triangulation in Table A.1.3 that loss development is faster in the 1986 and subsequent underwriting years. The report to report factors for these underwriting years are lower than for prior years. Table A.1.3 shows that the claims for older underwriting years are now showing stronger development, particularly after development age 8, and this was researched with the claims staff.

A.1.7 Discussions had taken place with underwriting and claims staff. These discussions covered the change in the terms and conditions of business written from 1986 onward, and the emergence, during calendar year 1986, of a particular claim type.

A.1.8 The first (underwriting) change was the placing of restrictions on the time period in which claimants could notify claims. This related to all policies issued after 1 January 1986. Previously, an unlimited time had been available. The intended effect was to reduce the period of time over which claims could deteriorate. The second (claims) change was the discovery that employees of some insureds were beginning to suffer from the effect of the environment in which they had worked. These problems had been latent, their emergence was now receiving press attention, and they were developing in a way which depended on calendar, rather than underwriting year, events.

A.1.9 The incurred development of these latent claims is shown in Table A.1.4.

Table A.1.4. Incurred claims - latents

Underwriting year	1	2	3	4	5	6	7	8	9	10	11	12
1982					2	2	3	4	6	8	10	12
1983				4	4	6	7	12	14	22	26	
1984			3	4	5	6	11	13	22	34		
1985		3	3	4	5	7	8	10	15			
1986	2	2	3	3	5	6	7	11				
1987												
1988												
1989												
1990												
1991												
1992												
1993												

A.1.10   These latent claims were then excluded from the triangle. Tables A.1.5 and A.1.6 show the development of the restated incurred claims triangle and the assumed development factors.

Table A.1.5. Incurred claims - excluding latent claims

Underwriting year	1	2	3	4	5	6	7	8	9	10	11	12
1982	38	52	62	70	76	82	86	89	91	94	96	99
1983	43	59	70	78	87	92	98	101	104	106	109	
1984	46	59	71	80	88	95	99	103	106	108		
1985	51	67	81	92	101	108	114	118	122			
1986	76	91	103	114	122	128	132	136				
1987	82	95	108	119	128	134	139					
1988	90	107	123	135	145	152						
1989	99	122	139	153	165							
1990	129	154	175	192								
1991	120	147	169									
1992	138	164										
1993	145											

Table A.1.6. Incurred claims - excluding latents

Underwriting year	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
1982	1.368	1.192	1.129	1.086	1.079	1.049	1.035	1.022	1.033	1.021	1.031
1983	1.372	1.186	1.114	1.115	1.057	1.065	1.031	1.030	1.019	1.028	
1984	1.283	1.203	1.127	1.100	1.080	1.042	1.040	1.029	1.019		
1985	1.314	1.209	1.136	1.098	1.069	1.056	1.035	1.034			
1986	1.197	1.132	1.107	1.070	1.049	1.031	1.030				
1987	1.159	1.137	1.102	1.076	1.047	1.037					
1988	1.189	1.150	1.098	1.074	1.048						
1989	1.232	1.139	1.101	1.078							
1990	1.194	1.136	1.097								
1991	1.225	1.150									
1992	1.188										

Selected report to report factors   Tail

	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	Tail
1982-1985	1.300	1.200	1.125	1.100	1.075	1.050	1.035	1.030	1.025	1.023	1.020	1.050
1986-1992	1.200	1.150	1.100	1.075	1.050	1.035	1.025	1.020	1.015	1.013	1.010	1.025

Factors to ultimate

	%	%	%	%	%	%	%	%	%	%	%	%
1982-1985	38.3	49.8	59.8	67.3	74.0	79.6	83.5	86.5	89.0	91.3	93.4	95.2
1986-1992	50.7	60.8	69.9	76.9	82.7	86.8	89.9	92.1	93.9	95.4	96.6	97.6

A.1.11   The data in Table A.1.6 show a change in development for the underwriting years 1986 and subsequent. This is in agreement with the change to the underwriting of the account which was intended to provide faster reporting of claims. The selected development factors are based on the data. Judgemental allowance was made for the development of the recent underwriting years after development age 8. It is necessarily judgemental, given the absence of any historical development, and will be one of the areas requiring careful monitoring. The tail factor for the older years was based on a benchmark for this type of business. The benchmark was compared with historic development, and was seen to provide a reasonable fit.

A.1.12   The report to report factors were successively compounded to give factors to ultimate.   The reciprocals of these are shown as percentages, and represent the expected percentage of claims reported.

A.1.13   The projection of ultimate incurred claims excluding latent claims is shown in Table A.1.7.

Table A.1.7. Incurred claims - excluding latents

Underwriting year	Reported claims (1)	Reported % (2)	Projected ultimate (3)
1982	99	95.2	104
1983	109	93.4	117
1984	108	91.3	118
1985	122	89.0	137
1986	136	92.1	148
1987	139	89.9	155
1988	152	86.8	175
1989	165	82.7	200
1990	192	76.9	250
1991	169	69.9	242
1992	164	60.8	270
1993	145	50.7	286
Total	1,700		2,200

A.1.14   As a test of the results of the incurred development method, paid claims (excluding latent claims) were also computed and projected. Table A.1.8 shows the results of the analysis.

Table A.1.8. Paid claims - excluding latents

Underwriting year	1	2	3	4	5	6	7	8	9	10	11	12
1982	15	32	45	57	66	72	77	81	85	88	92	94
1983	16	36	52	65	75	83	89	93	98	102	105	
1984	18	36	52	65	74	82	88	92	97	100		
1985	20	36	57	70	80	88	95	100	104			
1986	39	59	85	102	115	123	130	134				
1987	42	60	80	97	109	117	123					
1988	47	67	93	111	125	134						
1989	51	79	109	132	149							
1990	56	92	135	160								
1991	62	92	132									
1992	68	112										
1993	75											

A.1.15   Historic development factors and the derivation of assumptions are shown in Tables A.1.9 and A.1.10. The approach is the same as for incurred claims. The historic development of the paid claims data is more erratic than that of the incurred claims data, which is not unexpected, given the relatively sparse nature of the data.

Table A.1.9. Paid claims - excluding latents

Underwriting year	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
1982	2.133	1.406	1.267	1.158	1.091	1.069	1.052	1.049	1.035	1.045	1.022
1983	2.250	1.444	1.250	1.154	1.107	1.072	1.045	1.054	1.041	1.029	
1984	2.000	1.444	1.250	1.138	1.108	1.073	1.045	1.054	1.031		
1985	1.800	1.583	1.228	1.143	1.100	1.080	1.053	1.040			
1986	1.513	1.441	1.200	1.127	1.070	1.057	1.031				
1987	1.429	1.333	1.213	1.124	1.073	1.051					
1988	1.426	1.388	1.194	1.126	1.072						
1989	1.549	1.380	1.211	1.129							
1990	1.643	1.467	1.185								
1991	1.484	1.435									
1992	1.647										

Selected report to report factors

	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	Tail
1982-1985	2.000	1.500	1.250	1.150	1.100	1.075	1.050	1.045	1.040	1.035	1.030	1.100
1986-1992	1.500	1.400	1.200	1.125	1.075	1.050	1.035	1.030	1.025	1.020	1.015	1.050

Factors to ultimate

	%	%	%	%	%	%	%	%	%	%	%	%
1982-1985	14.7	29.3	44.0	55.0	63.2	69.5	74.7	78.5	82.0	85.3	88.3	90.9
1986-1992	26.3	39.5	55.2	66.3	74.6	80.2	84.2	87.1	89.7	92.0	93.8	95.2

Table A.1.10. Projected paid claims - excluding latents

	Paid claims (1)	Paid % (2)	Projected ultimate (3)
1982	94	90.9	103
1983	105	88.3	119
1984	100	85.3	117
1985	104	82.0	127
1986	134	87.1	154
1987	123	84.2	146
1988	134	80.2	167
1989	149	74.6	200
1990	160	66.3	241
1991	132	55.2	239
1992	112	39.5	284
1993	75	26.3	285
Total	1,422		2,182

A.1.16   There are, at this stage, two remaining questions. The first is the treatment of the latent claims. This is dealt with in Appendix 2. The second is the use of an exposure method, both as a further test and to assist in profit projections. This is dealt with in Appendix 4.

APPENDIX 2

TREATMENT OF LATENT CLAIMS

A.2.1   This   appendix   deals   with   the   latent   claims   excluded   from   the triangulations.   Paid and incurred claims are summarised in Table A.2.1 by underwriting   years.

Table A.2.1.   Summary of claims

Underwriting year	Paid claims	Incurred claims
1982	5	12
1983	6	26
1984	4	34
1985	4	15
1986	3	11
Total	22	98

A.2.2   The claims staff were asked to identify the insureds involved.   For the purpose   of   this   example,   we   will   assume   that   these   were   large   U.S. manufacturers,   and that the claims related to losses due to hearing loss.
A.2.3   As a first step, claims were tabulated by assured, as shown in Table A.2.2.

Table A.2.2.   Summary of claims

Assured	Paid claims	Incurred claims
ABC Manufacturer	11	52
DEF Manufacturer	6	7
GHI Manufacturer	5	26
JKL Manufacturer	-	13
Total	22	98

A.2.4   The underwriter was able to provide full details of all policies covering the identified insureds.   The policies were excess of self insured retentions.   A typical policy provided cover of, for example, U.S.\$10 million excess of U.S.\$20 million retention,   and the company had generally taken large shares of each policy.   Some of these data had not previously been available and were manually compiled.   It was recognised as important.
A.2.5   Claims staff had access to statistics and background   information   on

these claims. Medical research was also available, as were legal opinions on the various coverage questions.

A.2.6 Medical research indicated that impairment took place over the first ten years' exposure to certain types of working environments. Longer exposure did not lead to any further impairment.

A.2.7 Legal opinion was unanimous that these individual claims would be allocated to policies covering the year of first exposure, and were not allocated to subsequent years of exposure. In practice, the allocation of claims to years does not follow this highly simplified rule. Claims are allocated in different ways, which depend on the nature of the claim, judicial decisions, or market practices. Methods of allocation are generally not straightforward.

A.2.8 All individual claims allocated to a year could be aggregated for the purposes of recovery under these policies. If, for example, total claims for the underwriting year were U.S.\$3 million, then the company was liable for 10% of U.S.\$3 million less the self insured retention. It was decided, at this stage, that the problem should be approached by modelling the number of employees impaired. Average costs per claim would be derived and applied to these numbers. A loading for external expenses incurred in handling these claims would also be applied.

A.2.9 Table A.2.3 summarises data on numbers of claimants, and also shows projected number of ultimate claimants, based on the impairment model.

Table A.2.3. ABC Manufacturing

Underwriting year	Number of claimants (settled)	Number of claimants (notified)	Number of claimants (ultimate)
1982	1,575	3,041	7,576
1983	1,353	2,969	7,766
1984	1,614	3,258	7,878
1985	1,206	3,222	8,009
1986	1,105	3,068	8,010
Total	6,853	15,558	39,239

Loss Reserves in the London Market

Table A.2.4. ABC Manufacturing

Underwriting year	Number of claimants (ultimate) (1)	Average cost per claim (2)	Total claims costs (3)
1982	7,576	4.246	32,168
1983	7,766	4.564	35,444
1984	7,878	4.906	38,649
1985	8,009	5.274	42,239
1986	8,010	5.670	45,417
Total	39,239		193,917

A.2.10   These ultimate claim costs were then applied to policies, and costs at the company level were derived.   Company ABC had the most significant potential contribution, partly because of the extent of the coverage provided. Estimated ultimate claims are shown in Table A.2.5.

Table A.2.5. Derivation of cost to insurer

Underwriting year	Ultimate claims	Attachment point	Limit	Line %	Cost to layer
1982	32,168	10	20	100	20
1983	35,444	10	20	100	20
1984	38,649	10	20	70	14
1985	42,239	15	20	70	14
1986	45,417	20	30	80	20
Total	193,917				88

A.2.11   The projections indicate that the layers on the policies written in the underwriting years 1982 to 1984 will be total losses, and that the layers on the following two underwriting years will suffer partial losses. These two layers are clearly the areas with greatest potential for reserve deterioration.   Table A.2.6 summaries the analysis for all manufacturers.

Table A.2.6. Derivation of reserves

Assured	Paid claims	Ultimate claims	Claims reserves
ABC Manufacturing	11	88	77
DEF Manufacturing	6	55	49
GHI Manufacturing	5	79	74
JKL Manufacturing	-	31	31
Total	22	251	229

APPENDIX 3

PREMIUM PROJECTION

A.3.1 Premiums on policies written in a year are not normally fully reported in that year. There are delays as premiums are adjusted, some policies are swing rated and there are the normal administrative delays.

A.3.2 The triangulation process used to project premiums are the same as for claims. The historic development is examined and development assumptions are derived. Table A.3.1 shows the premium triangulation.

Table A.3.1. Reported premiums

Underwriting year	1	2	3	4	5	6	7	8	9	10	11	12
1982	61	65	66	67	67	67	67	67	67	67	67	67
1983	52	55	56	57	57	56	56	56	56	56	56	
1984	51	53	54	55	55	55	54	54	54	54		
1985	80	83	86	87	87	87	87	87	87			
1986	200	211	216	216	216	216	216	216				
1987	200	211	216	218	218	218	216					
1988	175	182	187	189	189	189						
1989	189	200	205	206	206							
1990	217	226	232	234								
1991	207	217	223									
1992	222	233										
1993	260											

A.3.3   The triangle and report to report factors are shown in Table A.3.2.

Table A.3.2.   Report to report development factors

Underwriting year	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
1982	1.066	1.015	1.015	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1983	1.058	1.018	1.018	1.000	0.982	1.000	1.000	1.000	1.001	1.000	
1984	1.039	1.019	1.019	1.000	1.000	0.982	1.000	1.000	1.000		
1985	1.038	1.036	1.012	1.000	1.000	1.000	1.000	1.000			
1986	1.055	1.024	1.000	1.000	1.000	1.000	1.000				
1987	1.055	1.024	1.009	1.000	1.000	0.991					
1988	1.040	1.027	1.011	1.000	1.000						
1989	1.058	1.025	1.005	1.000							
1990	1.041	1.027	1.009								
1991	1.048	1.028									
1992	1.050										

Selected report to report factors   Tail

	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	Tail
1982-1985	1.050	1.025	1.010	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1986-1992	1.050	1.025	1.010	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Factors to ultimate

	%	%	%	%	%	%	%	%	%	%	%	%
1982-1985	92.0	96.6	99.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1986-1992	92.0	96.6	99.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

A.3.4   The selected factors do not differ by underwriting year, because neither the data nor underwriter expectations indicate that development is likely to differ.

A.3.5   The data show continuing movements after year 5, although, given the size of these movements, further investigation is not considered warranted. These development assumptions are used to project the reported premiums to ultimate, as shown in Table A.3.3.

Table A.3.3. Projected premiums

Underwriting year	Reported premiums (1)	Reported % (2)	Projected ultimate (3)
1982	67	100.0	67
1983	56	100.0	56
1984	54	100.0	54
1985	87	100.0	87
1986	216	100.0	216
1987	216	100.0	216
1988	189	100.0	189
1989	206	100.0	206
1990	234	100.0	234
1991	223	99.0	225
1992	233	96.0	243
1993	260	92.0	283
Total	2,041		2,076

A.3.6 The estimated premium IBNR is 35 calculated as ultimate of 2,076 less booked of 2,041.

APPENDIX 4

EXPOSURE BASED LOSS PROJECTION

A.4.1 This Appendix sets out the derivation of a loss ratio index which is applied to estimated premiums to produce an a priori loss estimate. This approach is most often used for the more recent underwriting years of a long-tailed account where little, if any, loss information is available.

A.4.2 In order to estimate initial expected loss ratios, an index was derived. This index had three components, namely a rate index, a layer index and a coverage index.

A.4.3 The *rate index* measured the average change in rates charged, and was based on a large sample of policies which were both in force at the start of each year and renewed the following year. These samples were reviewed to ensure that no distortions arose because of large writings of new business different to that previously written, or because of non-renewal of substantial parts of the book.

A.4.4 The *layer index* measured exposure. The signed line, attachment point and limit were considered. A size of loss probability distribution was used to measure expected losses to the layer, with adjustments each year for assumed inflation, and the signed line was applied.

A.4.5 The *coverage index* was used to allow for the change in policy condition since 1986, which effectively excluded 30% of losses by value.

A.4.6 The year-on-year incremental values of these indices are shown in Table A.4.1.

Table A.4.1. Derivation of incremental loss ratio index

Underwriting year	Rate index	Layer index	Coverage index
1982	1.000	1.000	1.000
1983	0.900	1.200	1.000
1984	1.050	1.100	1.000
1985	1.600	1.100	1.000
1986	1.500	1.000	0.700
1987	1.100	1.100	1.000
1988	0.850	1.100	1.000
1989	0.950	1.000	1.000
1990	0.950	1.000	1.000
1991	0.970	1.000	1.000
1992	1.050	1.100	1.000
1993	1.100	1.000	1.000

A.4.7 Table A.4.2 shows the (compound) index and the derivation of the initial expected loss ratio.

Table A.4.2. Derivation of initial expected loss ratio

Underwriting year	Rate index (1)	Layer index (2)	Coverage index (3)	Total index (4)	IELR calculated (5)
1982	1.000	1.000	1.000	1.000	1.540
1983	0.900	1.200	1.000	1.333	2.054
1984	0.945	1.320	1.000	1.397	2.151
1985	1.512	1.452	1.000	0.960	1.479
1986	2.268	1.452	0.700	0.448	0.690
1987	2.495	1.597	0.700	0.448	0.690
1988	2.121	1.757	0.700	0.580	0.893
1989	2.015	1.757	0.700	0.610	0.940
1990	1.914	1.757	0.700	0.643	0.990
1991	1.856	1.757	0.700	0.662	1.020
1992	1.949	1.933	0.700	0.694	1.069
1993	2.144	1.933	0.700	0.631	0.972

A.4.8   The initial expected loss ratio is based on the results of the incurred development method for the 1982 underwriting year, and is calculated for subsequent underwriting years by applying the associated total index value to the 1982 base. In practice, a number of years would be used as the base, and the results compared for consistency.

A.4.9   The example shown in Table A.4.2 is highly simplified. Comparison of the derived initial expected loss ratio and those produced by the results of the development methods previously described show a far closer agreement than will be present in practice. Results which use one year as a base will often differ markedly from those which use another as a base. The exercise is, however, invaluable as a means of incorporating underwriting information into the process, and the research into why indications differ is often of great assistance.

A.4.10   Projected ultimate losses based on this method are shown in Table A.4.3.

Table A.4.3. Derivation of initial expected losses

Underwriting year	Estimated premium (1)	Initial expected loss ratio (2)	Initial expected losses (3)
1982	67	1.540	103
1983	56	2.054	115
1984	54	2.151	116
1985	87	1.479	129
1986	216	0.690	149
1987	216	0.690	149
1988	189	0.893	169
1989	206	0.940	194
1990	234	0.990	232
1991	225	1.020	230
1992	243	1.069	260
1993	283	0.972	275
Total	2,076		2,121

A.4.11   Table A.4.4 shows the derivation of ultimate losses modified by the claims experience.

Table A.4.4. Summary of direct casualty projected ultimate claims

Underwriting year	Initial expected loss ratio method (1)	Reported Bornhuetter Ferguson method (2)	Paid Bornhuetter Ferguson method (3)
1982	103	103	103
1983	115	117	119
1984	116	119	117
1985	129	135	127
1986	149	147	153
1987	149	154	147
1988	169	174	167
1989	194	198	198
1990	232	245	238
1991	230	238	235
1992	260	266	269
1993	275	281	278
	2,121	2,177	2,151

A.4.12   Column (2) = Column (1) x (100% − Percentage incurred) + Incurred claims. The percentage incurred is shown in Column 2 of Table A.1.7. Incurred claims are shown in Column 1 of Table A.1.7.

A.4.13   Column (3) = Column (1) x (100% − Percentage paid) + Paid claims. The percentage paid is shown in Column (2) of Table A.1.10. Paid claims are shown in Column (1) of Table A.1.10.

APPENDIX 5

CATASTROPHE LOSSES

A.5.1   This Appendix deals with the catastrophe losses arising from the Property Non-Proportional Treaty class of the insurer considered in the case study.   The insurer had provided excess protection to a number of different reassureds who have exposure to large property catastrophes.

A.5.2   The policies involved provide excess of loss coverage and were typically of the form U.S.$ 10 million excess of U.S.$ 10 million on which the company had taken a 5% line. On such a policy the 'exposure' is U.S.$500,000 per claim. Details of all treaties in force at the dates on which the catastrophe occurred were compiled.   The details recorded names of reassured, policy attachment point, policy limit, signed lines and nature of contract, (whether direct, direct reinsurance or retrocessional).   Contracts which were such that the loss would not be covered, for example because of territorial exclusions, were classed separately.

A.5.3 From discussion with underwriters and claim managers, it was clear that some policies had little further potential for future development, either because of the nature of the contract or because limits had already been exhausted. Others had significant potential. For each contract, the current incurred claim positions were recorded, as well as the date of last movement. The results of this compilation are summarised in Table A.5.1. This compilation is simplified in so far as it does not allow for the erosion of policy limits by other claims.

Table A.5.1. Summary of exposure and claims

	Exposure	Incurred	Ultimate
Front end cover			
Direct	10	7	7
Direct reinsurance	15	5	7
Retrocession	375	180	357
Subtotal	400	192	371
Back up covers			
Direct	7	1	1
Direct reinsurance	9	1	1
Retrocession	223	127	139
Subtotal	239	129	141
Excluded contracts	100	0	0
Total	739	321	512

A.5.4 The selected ultimate claims were based on a review of the reassureds in each grouping carried out with the underwriter. Direct and direct reinsurance had shown little movement in recent years, and a nominal allowance was included. In the case of only a few retrocessional contracts did it seem reasonable to assume less than full limits, particularly when the activity evidenced by the date of last movement was considered. A significant number of the cedants, who had purchased backup policies, had also purchased front end policies. The loss could affect one, but not both, of the policies, and this limitation was reflected in the estimated ultimates for the retrocessional policies.

A.5.5 It is also useful to carry out this analysis with further subdivision by rate on line. Rate on line is premium divided by layer size. Low rate on line indicates that the policy is a high layer policy, and only, therefore, exposed when a number of other polices have been exhausted. High rate on line indicates that the policy is a low layer policy, and exposed before higher layer policies. The classification can be used to refine assumptions. For example, policies included in the high rate on line category may be assumed to have a higher potential to be exhausted.

ABSTRACT OF THE DISCUSSION

Mr G. P. M. Maher, F.I.A. (introducing the paper): While there have been many papers which have discussed the theoretical aspects of the loss reserving process, there did not seem to be anything in our literature which set out to emphasise the practical aspects of this subject. This paper is intended to set out one view of the framework of the loss reserving process, and to provide details of the various steps.

The key elements of the process are the understanding of the business, the understanding of the data, and communicating the results of the investigation in a way which enables these results to be used, not only for the balance sheet, but also for other purposes.

Our estimates are uncertain, for various reasons. Appreciation of this uncertainty is important, both for understanding what the numbers mean and for ensuring that they are correctly used. It is probably true to say that many corporate decisions have turned out wrong simply because of over-confidence resulting from the failure to appreciate the uncertainty associated with the base information.

This is an extremely important area for an industry which has seen many insolvencies. The inadequate assessment of the underwriting contributions to profit has enabled some underwriters to live in a fools' paradise. It has also made life difficult for the better-informed competitors, appreciative of the costs of their risks, continuing to write in an overly competitive market.

Loss reserving is an extremely interesting subject. Nothing ever stays the same in this market, which makes it difficult, but enjoyable. It is also crucially important for the welfare of the insurance industry.

Mr J. R. Bulmer, F.I.A. (opening the discussion): This paper draws attention to the substantial and increasing role of actuaries within the London Market. Fifteen years ago, only a handful of actuaries practised in the London Market. By comparison, the membership of the London Market Group of Actuaries currently stands in excess of 100.

The increasing role of London Market actuaries is illustrated by the growing number of statutory functions which they are undertaking. For example, at Lloyd's actuaries are providing opinions in support of a solvency reserve lower than the Lloyd's Test 1 reserve. Actuaries also provide certificates of loss reserves for submission to the International Insurance Department in the United States of America, and this year, for the first time, actuaries are providing loss reserve certificates in respect of the liabilities of reinsurance accreditation trust funds for U.S. business.

The estimation of loss reserves is particularly important for a London Market insurer or reinsurer, in view of the nature of its business, which is often long-tail and volatile. It is not unusual for the loss reserves of such a company to be considerably greater than both shareholders' funds and premium income. This means that a relatively small percentage fluctuation in loss reserves may have a disproportionately large effect on both solvency and reported profit for a London Market company. Many of the comments in the paper relate to loss reserving generally, and the paper does not always highlight the particular issues which affect London Market companies, including this gearing effect of loss reserves on the balance sheet. A substantial element of uncertainty inevitably surrounds the estimation of the loss reserves of many London Market companies writing long-tail business. It is important that the actuary clearly describes the nature of this uncertainty, which may be non-stochastic, in his or her reporting.

Section 2 contains a review of the principal features of the London Market. It is not only companies underwriting business which have a requirement to estimate loss reserves. Brokers and other intermediaries need to consider the provisions they should set aside to cover their future claims-handling expenses in respect of business written in the past. Such provisions may be substantial, and may have to be borne by a reduced revenue base.

The paper describes the past problems of the London Market. In making projections and reporting, an actuary needs to be constantly alert to potential future problems, and must ensure that the scope and extent of the work is understood clearly by the recipient of the report. For example, one potential problem which is receiving increasing attention is the possibility of significant claims arising from environmental pollution liabilities in the United Kingdom and continental Europe.

The author refers, in ¶2.3.6, to inadequate pricing in the London Market as a contributory factor to market losses. This represents an excellent opportunity for actuaries to add value to the rating process of London Market companies. A considerable amount of work is already being done by London Market actuaries in this area, and substantial further development may be expected in the future. This is a particularly topical issue, as rates are reducing substantially again in certain areas of the London Market.

Section 5, entitled 'Analysing claims', represents the heart of the paper. The author is correct in saying that the use of sophisticated mathematical techniques should not distract from the importance of understanding the business and ensuring that data are correct. It is not possible to describe, in a paper of this length, all, or even most, of the techniques used by London Market actuaries to estimate loss reserves. Hence, Section 5 does not fully reflect the variety of methods which are available, giving too little weight to some of the more sophisticated methods which are used in practice. Although the chain ladder method and its variants are valuable and widely-used, the actuary has many other useful methods available, including techniques which project trends explicitly by underwriting year, and techniques involving the analysis of the data by underwriting year, development year and reporting year. Some of these methods depend on data being available in a suitable format, and they should not be used indiscriminately.

Given the importance of the analysis of outwards reinsurance in loss reserving for the London Market, Section 5.9 is too short. The structure of the reinsurance protections for a London Market underwriter is often extremely complex, and has a major impact on the patterns of claim development net of reinsurance. This is a fundamental, and often complicated, area of the actuary's work, which involves much more than the separate projection of major and non-major claims. Careful consideration needs to be given, for example, to the possibility of vertical or horizontal exhaustion of reinsurance protections, partly-placed layers, indexation clauses, exchange rates underlying protections, co-reinsurance, and inwards and outwards reinstatement premiums. The author, in ¶3.4.3, rightly draws attention to the excellent paper produced by Czapiewski *et al.* in this area.

Section 5.9 also discusses the projection of individual catastrophe losses. Based on my own experience of projecting such losses, I agree that curve-fitting techniques need to be used in conjunction with exposure analyses. Curve-fitting techniques used in isolation may fail to pick up late accelerations in claim development, which could occur if the London Market company has written a substantial number of high level or top and drop covers. Furthermore, evidence is starting to emerge of a backlog in claims processing in the LMX market in respect of insolvent companies. A substantial number of LMX claim advices may be currently gathering dust in the offices of central claims processing units, brokers and some London Market companies. Also, the LMX spiral is being held back, to some extent, by disputes in the market. Curve-fitting techniques used in isolation would not take account of such a backlog.

I disagree with the implication, in Appendix 5, that rate on line is a reliable indicator of whether a policy is high layer or low layer. This may be a misleading assumption under certain circumstances. Rates on line for catastrophe contracts increased sharply in the late 1980s, and experience suggests that rates are not necessarily consistent at different levels of an excess-of-loss reinsurance programme. Also, rates on line for top and drops, cascades and back-up policies may not necessarily be a fair reflection of the relative risk of a claim under such contracts.

The author correctly emphasises clear reporting in Section 6. Indeed, the provision of actuarial reports on loss reserves is covered by professional guidance, although GN12 appears to have been formulated with short-tail rather than London Market business in mind. It may be that the time has come to review GN12 again, in the light of the substantial and increasing amount of work being undertaken by actuaries in the London Market.

The author gives an interesting example in Table 7.3. However, it appears that 100 may not be an unbiased estimate of the net claims reserve for Company A. The application of a company's excess-of-loss reinsurance protections to an unbiased estimate of an individual loss, gross of reinsurance, will not produce an unbiased estimate of that loss net of reinsurance. To take an extreme, but possible, example, the best estimate of the ultimate value of an individual large loss may be $100 million, gross of reinsurance, and this may be covered exactly by $100 million of vertical reinsurance protection. However, a best estimate of the ultimate net loss would not be zero. This is a particular issue for

London Market companies, as there may be considerable uncertainty surrounding the estimate of gross liabilities.

It is important for papers with a practical emphasis to be produced, in addition to those that are more theoretical. Thus, this paper is a useful contribution and will be of value to practitioners in the London Market.

Dr N. D. Hooker, F.I.A.: Although ostensibly about loss reserves in the London Market, this paper is, in reality, about the role of actuaries in advising London Market insurers, with particular emphasis on loss reserves. Many papers have been written on the methods of estimation of loss reserves — few, if any, have addressed the process. Indeed, it is rare for a paper presented at the Institute to cover all three of the actuary's main tasks in a loss reserving assignment: collection of data; performance of the analysis; and presentation of the findings.

There has been little attention paid in the actuarial literature to the two-way aspect of communication and the benefits to be obtained from discussions with other specialists, both to obtain their valuable insights and to ensure that the actuary's findings are challenged and understood, as fully as possible, by those who will act in response to them. The actuary needs:
(1) skill in probing for information, in order to uncover situations in which traditional techniques are likely to fail;
(2) skill in making adjustments, where appropriate, to the traditional techniques, or in devising new techniques; and
(3) skill in explaining the results of the investigations and analyses to the various interested parties.

Only by having and applying these skills, can the actuary hope to do better than the 'black box' reserving systems that are on the market and readily available to insurers.

Applying the standard techniques to development triangles may have been one way for an actuary to add value to an insurer's operations in the past, but, as actuarial involvement in non-life work has increased, these basic techniques are no longer enough. Actuarial science and its application move on, and we, as a profession, must take care to live up to the image of ourselves that we have promoted.

It is no exaggeration to say that a quarterly (or even more frequent) actuarial review can be the linchpin of the operational management of each major line of an insurer's business. I agree with the author that formal reports on such reviews should be produced for each line. Ideally, these should be produced by an actuary dedicated to that line, or at least one who is familiar with the range of contracts written and the pricing techniques used.

There can, however, be a perception, in some quarters, of a lack of independence if the same actuary is involved with both pricing and reserving for the same account. Such a view can be put forward as an argument for not including actuaries in the highest level discussions within an insurance operation, and could gain ground as actuaries make further inroads into pricing and other areas of management. In my opinion, this view can, and should, be strongly challenged. In this context, our training in professionalism and our specific codes of conduct should help. I am convinced of the benefits of actuarial involvement in pricing work, and believe that they substantially outweigh any difficulties caused by the perceived lack of independence in relation to reserving. Nevertheless, it is good practice for a peer review process to be in place. The profession will, sooner rather than later, need to address the issues of independence and peer review.

Quarterly actuarial reports should form the focus for debate on the results of the line of business, involving the actuary, the account manager, the senior underwriters, one or more claims manager(s), an outwards reinsurance manager, an information systems manager and a finance manager. Just as the actuary should have a degree of healthy scepticism towards what he or she is told by underwriters, so the other members of these teams should be encouraged to adopt a critical view of the actuarial analysis. This can be an excellent way for actuarial analyses to be adapted to the particular needs of the insurer.

There should be a process of continual improvement in the understanding of the account, and the actuary is well placed to help bring this about. The actuary could also use regular meetings on reserves to promote the benefits of an actuarial approach in other areas such as pricing. In particular, the actuary can help other managers to understand the various contributions to profitability:

(1) by quantifying the benefit of investment income;
(2) by incorporating claims handling and other management expenses;
(3) by providing sensitivity analyses to indicate the variability of results;
(4) by assessing the exposure to loss from accumulations of risk and non-recovery of reinsurance; and
(5) by incorporating appropriate capital allocation models.

Mr M. Bride, F.I.A.: The third and fourth sentences of the abstract read "The use of sophisticated mathematical techniques should not distract from the importance of understanding the business and ensuring that data are correct. Sophisticated mathematical techniques can give rise to misleading impressions of confidence and accuracy to estimates, which are often subject to considerable uncertainty." In the approach to loss reserving put forward in this paper, the actuary is defining an extremely complex model, which is far beyond his or her ability to analyse using what one might call statistical techniques. There are good reasons why this approach might be taken in certain situations. The fundamental trade-off in loss reserving methods is between an accurate point estimate or range and the statistical information available from a more rigorous approach.

Very broadly, the author defines the objective of loss reserving as contributing to financial stability by assisting in the estimation of the largest balance sheet item, and aiding management and planning via the inferred profitability of past business. In the context of the London Market, methods, such as those laid out in the paper, offer much more than the statistical methods that we can currently manipulate when looking for a balance sheet estimate. If the actuary chooses the mathematically simpler route, it is important not to lose sight of some of the basic principles of probability.

It would be very informative to ask a selection of actuaries to estimate loss reserves, using the techniques of this paper, on data that, unbeknown to them, had actually been generated from known statistical distributions. We could then see how the various reserve estimates derived related to the distribution moments. As a profession, I believe that we do not do enough to study the effectiveness of the techniques we use over time and across classes of business, because few of us have the opportunity to look at our results over many years to see whether our estimates were close or far away, and the reasons why they might have been far away.

If we turn towards the management and planning of a business, then I think that there is a greater need to turn towards the sophisticated statistical models. There are several reasons for this:
(1) Although it is properly the subject of another discussion, I believe that the expected value of claims is the appropriate figure to use when assessing profitability of business. This figure is never readily to hand, using the types of techniques outlined in this paper.
(2) Taking full advantage of profitable opportunities is an important aspect of trading successfully in any competitive market, and particularly the London Market. The actuary following the methodology laid out in this paper will be reasonably successful in identifying, at an early stage, that reserves should be higher and that business is unprofitable, but I am not convinced that the same is true in the case of very profitable business with low reserves.
(3) The planning of future business is uncertain, and will be subject to organisational politics. Reserve figures generated using sophisticated mathematical techniques may well be more widely owned in the planning process, and therefore more influential, in determining the future strategy of the company, irrespective of whether the reserve estimate itself is actually 'better' or 'worse'.

If a particular class of business is likely to be exposed to latent claims, then this should be reflected in the estimators of profitability, even if, for the purpose of setting balance sheet reserves, those claims do not represent a liability, as defined by the governing principles of accounting. In Section 5.10 the author discusses exposure-based methods as a means of estimating the costs of latent claims. This is a valuable approach in relation to latent claims that are known to exist, but not for claims that may be present, but whose nature is unknown, and, therefore, for business planning, we must return to the more statistically-based methods.

Mr J.P. Ryan, F.I.A. This is a useful, practical paper, which provides much insight into the techniques used to come up with loss reserves, although how the results and other matters are

interpreted may vary, according to what you are trying to do. However, basically, the techniques outlined in the paper give a clearer idea of the directions that the reserves are taking.

The opener suggested that GN12 needed to be reviewed. The General Insurance Board has anticipated him, and has set up a working party to do that.

In Section 5.2 the author discusses segmenting and aggregating the data. A popular myth is that a good segmentation is one which results in triangles that all look reasonably smooth. In many cases you may need to segment further than that, and get some slightly rough and ready looking triangles; it depends on how closely the development patterns are related, and whether there are any changes in the mix of business.

In Section 5.8 the author emphasises that it is important to use more than one method. One reason is that this allows differences in the operations to be identified. The London Market organisations rarely stand still for long, and, therefore, the conventional assumptions that one might make about stability do not apply. Very often the current mix of business has changed from the earlier part of the triangle. A good method can be one that exaggerates the differences. It may be terrible from a statistical point of view, but, for an actuary operating in the London Market, very often it can highlight important factors in the account. When presenting the results, it may be sensible to tone it down a little, or move it in another direction, but the differences and the way that they are exaggerated can be particularly useful.

The author uses and discusses the Bornhuetter-Ferguson method to some extent. This is not, necessarily, a premium-based method. The London Market often uses a base with expected loss ratios, but the original paper goes back and requires some a priori estimate of the losses. This explains Mr Bride's point that, in highly profitable areas, the actuary can sometimes be reluctant to go for a very low loss ratio and, hence, produce very good results. Using other means of forecasting results a priori can lead to better methods, although very often in the London Market the loss ratio is the only reasonable measure of exposure.

Statistical methods are, of course, extremely useful in measuring the stochastic element of variability. However, they do not measure model and parameter uncertainty. In the London Market these can be much more important than the stochastic variability, particularly as London Market underwriters are generally quite good at restricting line sizes and, with one or two notable exceptions, carefully protect themselves by way of reinsurance. The author's approach lends itself much more to exploring the model and parameter uncertainties by using sensitivity analysis. The insight gained by using this approach can supplement the conclusions reached by more formal statistical methods, and this is an area where the profession needs to develop more work.

In ¶6.1.7 the author suggests that graphical and other breakdowns of the reserves are a very important part of the actuary's report. I have come across a number of cases where companies do not know that the breakdown of their reserves is very different from the business the company is currently writing; a company that has pulled out of long-tail lines may find that its long-tail business takes a very long time to run off.

In ¶4.1.4 the author emphasises that it is helpful to liaise with the auditor. Much reserving data that the actuary comes across are outside the scope of the audit. While auditors can be helpful in this area, the actuary needs to make some checks. The U.S. conduct guides impose an obligation on the actuary not to use totally unreliable data.

I agree strongly with the central message of this paper. It is very important to understand the business first, and to be an actuary second. This paper is a valuable aid to those of us who practice in this area, and should act as a caveat to the pitfalls. In order to practise extensively and sign certificates, an actuary needs to have access to people who understand the detail of the account.

Mr D. H. Craighead, F.I.A.: Actuarial analysis, to the extent set out in the paper, would impose requirements on both the actuary and the underwriting staff that may take several months to satisfy. Nevertheless, if the work cannot be completed in time for the first valuation to be made, it should lead to the possibility of completion when valuations are carried out in subsequent years.

Another difficulty is that many of the smaller syndicates, even many of the companies, do not have the computer facilities necessary to provide many of the figures required by the author. The position

has improved considerably over recent years, probably partly as a result of pressure from actuaries, but some of the author's requirements could not be met.

I have more fundamental objections to reliance on the link ratio (or chain ladder) method, which forms the foundation of the reserving calculations. To be successful, such a system requires that the tranche of business being considered varies little from year to year. Such a continuance of claims development factors can be expected in the case of a large direct-writing company, but is not the nature of the London Reinsurance Market. In our market, major changes can, and do, occur from year to year. Such disturbing factors as latent claims, on the one hand, and catastrophe claims, on the other, can be allowed for by deducting the relevant claim figures and examining them separately, as has been provided for by the author, but even the residual portfolio does not remain invariate in regard to claim development factors. The nature of the business being offered to the market may, and often does, change rapidly. The policy of the underwriter may change. The underwriter himself/herself may change. The groups of business being considered are seldom homogeneous, and the percentage of their constituent elements may change, or the claims may arise from different sources. When considering the net account, changes in the portfolio of reinsurance protections will have a major effect, and may affect different classes of business differently from year to year. The effect can be very great indeed in estimating net reserves, even after catastrophe claim amounts have first been deleted. Where the reserving process is based on paid claims, the rate of settlement of claims may alter materially, as, in fact, has happened during the last few years in the London Market.

In other words, the chain ladder method is valuable in providing assistance for the claim developments of the later years of account as derived from earlier, more complete years, but falls down when the claims development pattern itself changes. The paper covers the case of one obvious break, but generally the picture is much more complex and erratic or the changes are gradual and disjointed.

The author makes use of the Bornhuetter-Ferguson modification. There are difficulties, in practice, in estimating variations in the average rate of premium charged, but I find the method a useful adjunct in the first two years of account; perhaps in the third and fourth year of a liability account; even further for a liability account where only paid claim amounts or ratios are available; but it is only useful, in general, if it leads to an increase in reserve figures; not to a decrease.

I am surprised that the author has rejected curve-fitting methods, because they have the advantage that they overcome the difficulty of the independence of the claim development patterns of different years of account, but can still draw support for the later years from the earlier years by comparison of the values of the parameters determined within the process. In fact, variations in the parameters are very useful in showing up steadily growing changes in the nature of the development pattern, as against the sudden change that is handled by the author in his analysis. Where necessary, the parameter that is a measure of the length of the tail of the business can be pre-set. Also, the fitted curve provides a picture against which judgements can be made, particularly as to the tail factor so developed and its likelihood of being correct. In particular, claims on liability business may easily take 20-25 years to final settlement, and tail factors may be extremely difficult to determine without such a visual aid. Outside pictures of settlement patterns, such as are provided by RAA statistics, may, or may not, be suitable, and their suitability may often best be determined by visual comparison with a fitted curve of the actual development pattern under consideration.

Curve fitting is not, however, of much use in the earliest stages of development. For best results, both methods — link ratio and curve fitting — should be used in conjunction with one another.

Mr D. M. Hart, F.I.A.: I found this paper to be a useful and practical collation of material relevant to the London Market. It has become particularly topical as a result of the Equitas project. I was pleased to see how practically the subject had been treated, as I consider this to be vital in ensuring that the management and the underwriters are able to relate to the advice being given by the actuary. In particular, the emphasis on understanding the business written is most important. Without such knowledge of the portfolio and reinsurance protection purchased, the profession's credibility in the market will be very limited. The types of features that may be discovered by a detailed understanding of the portfolio are well outlined in Section 5. I was, however, disappointed that, having selected three

specific situations to consider in more detail in Section 5.11, the author provided limited detail on his preferred solutions.

There are three imperatives of reserving in the London Market. These relate to data, reinsurance and communication. The author has covered all of these to a varying degree, and I have no major disagreement with what he has written.

Provision of accurate data on a consistent basis suitable for reserving is a problem for most London Market underwriting organisations. As a result, the actuary is often constrained in his or her choice of methodology. Problems arise for a variety of reasons, many of which reflect the way the records have been kept historically. Very few London Market players have had computer-based systems for more than 10 years or so, and a considerable proportion for a much shorter period. Even when such systems were introduced, they tended not, until recently, to be integrated, so that there were no interfaces between policy, claims and accounting records. In addition, much of the accounting and claims handling is carried out on behalf of the market by central bureaux, reflecting the subscription nature of the market. There is nearly always difficulty in relating premiums and claims accurately to one another. This is particularly unfortunate, given the emphasis within the market on ensuring that claims are attributable to the same underwriting year as premiums. The lack of historical records on a computerised basis is also a major obstacle to the identification of exposures to specific types of claim, such as asbestos-related claims. Retrieval of such information from the paper or card-based records of twenty years ago is an almost impossible task. If the complete records can still be found, which is doubtful, they are unlikely to contain sufficient detail to give a full picture of the situation. Given the long-tail nature of much of the business, it will take some time before the strides which have been made to improve record-keeping realise their full value for reserving purposes.

Reinsurance is very important to the majority of London Market operations. London Market underwriters, as a general rule, buy a great deal of reinsurance protection both on proportional and non-proportional bases. As a result, the net data for a London Market account can be substantially distorted, as the opener has described. It is often appropriate to work on figures which are net of proportional reinsurances and reinsurances which are risk specific, but gross of whole-account non-proportional reinsurances, and then treat this latter category as a separate 'negative' class of business. This relates more closely to the way in which the business is written.

Communication is a vital aspect of any general insurance actuary's approach, particularly in the London Market where there is a particularly low historical exposure to actuarial ideas and a wide range of levels of numeracy.

Mr A. J. Newman, F.I.A.: The paper looks at latent claims in Section 5.11 and Appendix 2. However sophisticated the methodology used for the asbestos direct insurance in this case is, it needs to be emphasised that the future latent claims sources are not allowed for. Mr Bride suggested that, in the pricing work, we allow for unknown latent claims (before we know what, how and why) using sophisticated statistical methods. I would like to know what these might be.

While I agree that claims with unusual developments should be stripped out, the rump of the account may then have no development and reserves will be too low. The actuary ends up behaving like the claims manager. He or she spots all the moving claims, reserves for them appropriately, and allows zero IBNR on the rest. Then a claim comes through — the actuary calls it a latent claim, whereas, if the account had been projected on a more aggregate basis, it would have been reserved for properly.

As the author points out, in ¶6.1.6, the documentation provided by the reserving exercise can prove very useful during the year.

The great strength of this paper is that it justifies the incursion of the actuary into the London Market. It is as a consultant, whether internal or external, that the actuary adds value to the reserving process.

Mr K. P. W. Larner, F.I.A.: London Market business is some of the most complex in the world, and gives rise to some of the most intractable of actuarial problems. The clarity of the paper and its exposition of actuarial techniques might suggest that the actuarial profession has solved all the problems already. This is far from the case.

The author's emphasis on understanding the business, on getting the data right, and on the use of modest techniques is exactly right at the present time. We all look forward to the day when data have been collected for more than 10 years in the same way, there have been no changes in the mix of business, in the contract wordings and in the reinsurance arrangements, and when the underwriter, the claims administration and all other issues in the assessment of reserves for each class of business have not changed. Until then our steps, as a profession, must be small and well caveated. These words from ¶3.1.1 cannot be over-emphasised: 'nothing ever stays the same'.

Benchmarks are discussed in Section 5.4. For most classes, even with a modest length of tail, let us say 10 years, there is usually significant development beyond the experience for analysis. This is particularly the case for paid claims. In many cases the selection of the tail factor on an account is the single most important financial assumption made. It is often, also, the most uncertain assumption. The uncertainty is associated less with random variation in future claims development as with misinterpretation of the mix of business or the lack of availability of a quality benchmark. Even where a range of benchmarks is available for a class of business, one must be aware that, typically, as much variation in benchmark can occur between looking at the same class of business for different companies as within the same caption of business. As a profession, we need to consider how much we should seek to protect a colleague from making a significant mistake in a financial assumption, in the absence of data, as a result of using a bad benchmark, and how much that colleague should be encouraged to seek external advice.

Paragraph 5.5 discusses premium projections briefly. There are circumstances, such as swing rated plans or where business carries profit commissions, where premium development can be heavily linked to claims development. The impact of underwriting cycles will distort the premium development in this case. In different markets the rules for, and the timing of, the premium adjustments need to be well understood.

In Appendix 4 a loss ratio index is estimated, using a combination of a rate index, a layer index and a coverage index. This particularly focuses on excess of loss business, which can emphasise the financial aspects of the contract rather than the underlying claims. For example, it is important to know whether excess of loss business is well away from a working layer or near a working layer. Different types of business can be considered in a similar fashion, because the financial characteristics of the contract are more important than the underlying claims. There is a need for an index of the quality of risk management on the underlying risk. For instance, if an actuary has knowledge that, due to risk management activity on the original risk, either the number or quantum of claims is expected to decrease, then this should be allowed for in this index. This has been a particular issue in certain marine insurances, but also on professional indemnity lines. It is an area where a detailed knowledge of the underlying risk is important.

Mr S. A. Malde, F.I.A.: The paper provides a clear description of the practicalities of the reserving process. I can visualise it leading to an improvement in the reserving exercise in two ways: it is going to be useful as a reference work; and it is going to be useful in communicating the reserving process to other market practitioners. I hope that it will also show that actuaries do the job well, and let us hope that it does not imply that the job is easy to do.

Data limitations are referred to a number of times in the paper, and several speakers have described how poor the data have been in the past. There is not much that actuaries can do about past data, but we should try hard to influence the market to improve the quality of data in the future.

Section 5.7 deals with a rating index and rating improvements. When actuaries speak to underwriters, we must treat what they say about rating improvements with caution, as they often do not materialise. This index is extremely important for the most recent years, but the difficulties in producing this sort of index should not be underestimated.

Although I applaud the clarity of the paper, the simplified example that is used in the main text is slightly misleading. If my answers from different methods were so close to each other I would be a happy man.

Mr P. H. Hinton, F.I.A.: I have been surprised, over the years, at the very high involvement of actuaries in the London Market. It is surprising, because the business is one of the branches of general

insurance least amenable to classical actuarial techniques, and I do not think it is entirely for the reasons that have already been stated. We are not the only people who are numerate. We have training and experience in appropriate techniques, but these techniques are not secret, they are in the public domain. There are others with understanding of the market. There are others prepared to ask questions and admit ignorance. We are not the only people able to determine what the proper data are, and not the only people who can conduct investigations to assemble the data. What I think distinguishes us, is that we can be relied on, as a profession, to analyse the data dispassionately, and tell it like it is, however inconvenient this may be to our employer or client.

In Section 7.4 it is noted that future investment income is often used as an implicit margin to offset possible under-reserving. This is an unsound practice, and, indeed, it is about to become illegal with the implementation of the Insurance Accounts Directive. All liabilities must be provided for explicitly. The Insurance Accounts Directive will give another upward turn to the ratchet of actuarial involvement, because, not only may more people have to discount, but also companies are going to assess gross reserves, sometimes for the first time.

The point was made in various places in the paper about small classes of business being important. There are many companies with a small involvement in the London Market which are regretting that small involvement.

I would like to reiterate the point made by other speakers about uncertainty. Unless we communicate that uncertainty, wrong decisions will be made on pricing, and companies will write business on the basis of expected profitability and not with regard to the uncertainty.

Mr D. J. Hindley, F.I.A.: This paper is a useful introduction to a topic that takes up a large proportion of many general insurance actuaries' time. It overlaps slightly with the monograph produced by the London Market Actuaries Group in 1989, that placed quite a lot of emphasis on Lloyd's.

As shown in Figure 2.1, Lloyd's makes up a significant share of the London Market, and, apart from brief consideration of Lloyd's stop loss policies, there was not that much consideration given to Lloyd's in this paper. However, an actuary needs to be aware of a number of aspects of Lloyd's that impact on a loss reserving exercise. For example, premium movements after development year 3 are still sometimes netted off the claims development, which can cause distortions to the claims development triangles. Another example is that the audit code classification used by many Lloyd's syndicates for their reserving can sometimes contain a wide range of business, so that an underwriting classification may be preferable.

One other aspect of the market, that is not specific to Lloyd's, is the use of the slip system, as discussed in ¶2.2.2. This makes it quite easy for an underwriter to write a very diverse book of business, both by class of business, territory and attachment point. He can also vary his line size significantly between risks, if he chooses to do so. This means that it is sometimes difficult to construct reasonably-sized homogenous data triangles, and some compromise may have to be reached.

The paper rightly emphasises the importance of talking to underwriters, claims staff, etc. However, in practice, it is often only possible to make subjective adjustments to the reserving process as a result of their input.

In ¶3.2.2 the author states that it can be useful to consider whether any data can be compiled to support the changes in development assumptions that an underwriter has suggested, but which have not yet shown through in the triangles. Presumably the author is thinking of data such as the number of claims settled, etc. In my experience, it is often the case that changes in development assumptions, particularly those that refer to a speeding up of development, suggested by the underwriter, do not show through clearly in the data. It is often not possible, either within the time available, or with the data that are available, for the underwriters or claims managers to produce hard evidence that the development has speeded up. The question for the actuary is how to adjust the answers to reflect what is, essentially, just a subjective view of the underwriter or claims manager.

In ¶2.3.2 the spiral market is mentioned, with particular reference to the large natural catastrophes that occurred in the period 1987 to 1992. The spiral market is again referred to in ¶3.4.4, which leaves the impression that catastrophe losses will always spiral around the market. I assume that the author did not mean this, because I think it is generally accepted that, although the spiral has not

disappeared entirely, its extent has diminished since the late 1980s. To try to reduce the uncertainty as to the extent of the spiral, perhaps we should be developing some form of index that would summarise this, maybe by measuring the volume of within-market retrocession. As this index rose, it might provide a useful indicator to the market that the spiral was starting up again.

I was surprised that such a practical paper did not refer to the use of graphs to assess reserve estimates for reasonableness. In the London Market, where, as the paper and many speakers have reminded us, the data are far from perfect and complex techniques may not work, graphs can be an extremely effective tool in the overall process. I looked at the tables of the data in the appendices, and the change in the development pattern from 1986 onwards is immediately apparent, although it does seem to be concentrated in the first year of development. The change in pattern is, of course, also apparent from the data alone, but this may be because the data included in the appendices are rather smooth. In practice, with more volatile data, I find graphs an easier way, when combined with discussions with the underwriter and claims staff, to spot such changes or other features and anomalies in the data. They are also a very effective way for an actuary to communicate his or her results to the client.

Mr C. Miranthis, F.I.A.: Having had a number of papers dealing with various statistical aspects of the reserving process, those of us that work in the London Market welcome a paper like this, which brings home the realities that we have to deal with. Speaking as a consulting actuary, I estimate that more than half of our time is spent in ensuring that data are correct and reconcilable to the accounts.

The London Market has, historically, been dominated by the brokers who had control of the data. Computerisation has occurred over the last ten years, but often from an accounting perspective, with all statistical data being kept in a separate system. As actuaries, we have an important role to play in ensuring that this situation does not persist.

The author does not appear to recommend any one projection method in preference to any others. On the contrary, he uses a number of different methods. The point is that methods must be appropriate for the type of business being considered. This problem exists outside the London Market, but, perhaps, not to the same extent. London always took pride in its reputation for quoting on business that others found too complicated to analyse.

The paper does more than illustrate the pitfalls of the London Market. It presents reserving as an integrated process involving underwriting and claims, with implications for reporting and pricing. Actuaries need to do further research in this latter area, and need to present their results in such a way as to convey the uncertainty of estimates. I agree with the author that pure stochastic uncertainty is *often not the most important method. Actuaries need to convey the parameter uncertainty of the* 'drivers' of their estimates. A form of standardised wording to describe estimates might be useful.

The reserving process can deliver a range of by-products that can be used by underwriters to monitor and adjust rating structures as the account develops. Similarly, actuaries can develop estimates (and by this I do not mean just cash flow estimates or currency allocation of reserves) which help with the investment strategy. For example, if factors can be identified that 'drive' the uncertainty in the reserve estimates, these factors may be matched by suitable investment instruments. In Section 7 the author touches on these issues, but, only when they come to be viewed as an integral part of the reserving process, can we truly say that we have a proactive position in the London Market.

Ms C. Barlow, F.I.A.: I would like to add a couple of words to the title of the paper, and they are 'and Elsewhere'. Although presented as a London Market paper, many of the issues raised are relevant to the reserving process in general. Coming from outside the London Market, I believe that the main principles apply. The fundamentals of getting appropriate data, understanding the data, understanding the business, using a method suitable for the line of business concerned and, not least, communicating the outcome to the people who are interested in the reserves are the key elements of the process.

Over-technical and ill-communicated work will not add value, and will not produce the good professional effect that is deserved by the effort that has gone into it.

Mr V. S. Baker, F.I.A.: One area which is a burning issue in Australia is uncertainty in our

estimates. In Australia, actuaries are usually required to advise a central estimate of outstanding claims and to recommend a prudential margin over and above that estimate. There are three approaches currently in use. The first is a highly statistical approach, which calculates the stochastic error and the systemic error, which might be called the parameter error, and then arrives at a standard deviation of the claim costs. From this, a probability of reserves being adequate is calculated. The second method is to assign margins, varying by line of business, say 5% on motor insurance or 20% on long-tail business. The third approach is a sensitivity analysis of the effects of the change in assumptions on the central estimate.

There are problems with each of these methods. It is possible to calculate the stochastic error for some claim distributions, but not the systemic error. People who say that there is, say, an 80% chance of having adequate reserves are not completely correct. Adopting standard margins per line of business is merely opting out from the problem. As for the sensitivity analysis, assumptions can be altered, but it is very hard to quantify what is a reasonable departure from the base line assumptions. Thus, the area of the measurement of uncertainty needs more research.

Mr A. R. Jones, F.I.A.: I, like many other speakers, endorse the author's emphasis on understanding the business, rather than applying complex mathematical techniques.

In many areas the language in the paper is unequivocal and absolute. For example, in ¶3.2.4 the author writes "It cannot be over-emphasised that the actuary must understand the coverage provided". We are living in an increasingly litigious climate, where standards of professional practice are evolving. We must be wary about setting standards, or being perceived as setting standards, that, in practice, may be unattainable. Thus, there are many parts of the paper that should be viewed as a check-list of the issues that the actuary should be trying to address, where it is practical, rather than as the absolute imperatives that they appear to be.

Section 5.11 describes a methodology used for reserving for asbestosis claims. Many uncertainties remain, even after applying this complex approach, largely because there are interactions between what individual assureds are paying and also between the average claim cost of individual assureds. Whereas I wholly endorse that data claims should be built from the ground up, information is also needed on policy exposures. A simpler approach may often be a better balance between accuracy and effort.

At Lloyd's, no Name can insure himself on a stop loss policy, and so another step needs to be included in the method described in Section 5.12. Losses attributable to a Name who supports any stop loss syndicates are re-spread away from the syndicates that he participates in.

Exposure-based loss projections can be invaluable in the early days of an underwriting account, but claims can vary from year to year. Another variable is the cost of reinsurance (either the amount paid for the same cover or the amount of cover itself), which can be a bigger influence on the net bottom line than the gross rates at which inwards business is written.

Mr R. Manjrekar, F.I.A.: This paper is a good illustration of how actuarial papers should be produced for wider consumption, in order to raise awareness of what the profession has to offer. I would be happy to pass this paper on to my underwriting, claims and finance colleagues with the expectation that it would be more likely to be read and understood than more esoteric and technical actuarial papers.

Reserving is a vital component of the information network and feedback loops, whereby planning, pricing and reserving within a company can be linked. For the more recent underwriting years, the plan loss ratios can provide good and consistent initial loss ratio assumptions used in methods such as the Bornhuetter-Ferguson method, described in the paper. Reserves based on plan ratios and latest premium estimates can be effectively monitored and tracked until credible data become available for applying the projected paid and incurred loss methods. Feedback loops provide senior managers and underwriters with up-to-date information about the best estimates of ultimate losses for more recent underwriting years, and possible reasons for adverse or favourable indications, so that better planning and pricing decisions can be made.

The role of the in-house actuary in the London Market is developing beyond reserving, into areas such as providing support to the underwriters and claims staff, and providing input to the corporate

planning process. The actuary can add value to the pricing function by providing technical support on large and complex individual risks, or identifying profitable/unprofitable sectors at a portfolio level, with the reasons for such conclusions. The actuary may also be involved at a macro level in determining effective use of capital, the types and levels of business to be written, matching of assets and liabilities, designing cost effective outwards reinsurance programmes, optimising allocation of expenses and testing dynamic solvency.

Many of these responsibilities are required of the actuary in a life office. Although a statutory actuarial role within general insurance may not be forthcoming for some years, the profession should gear itself towards being in a position to adopt such a role in due course.

Mr C. J. W. Czapiewski, F.I.A. (closing the discussion): In the second sentence of the abstract the author says that "the process is not simply a series of mathematical calculations". Unfortunately, this is quite often the view that non-actuaries have of what we do; that is, until we give them a report or analysis of what we have done. The actuary brings added value to loss reserving in broad general ways and in detailed technical ways.

Broadly, he or she brings expertise in checking, understanding, analysing and manipulating the data. The actuary makes use of data derived from the insurer itself plus external data which may be used very carefully where it is appropriate and where it is necessary. Often this is essential for selection of the tail factor. The actuary also brings a structured approach to reserving, so that methods can be followed through, justified and reconstructed at a later date, perhaps by using enhanced and more up-to-date data. The actuary can also bring an independent view of the reserves required (assuming that he is not in conflict by being too involved in the pricing side). Technically, he can allow for changes in the profile of the business written, such as an increase in reinsurance retentions. He can allow for a change in the format of the business; for instance, going from a losses occurring to a claims made basis. He can allow for aspects of the business such as outwards excess of loss reinsurance protection.

The actuary must not:
(1) treat the exercise as a 'black box' number-crunching process;
(2) sell his reserving package to clients that do not have actuarial skills as the solution to their reserving problems; and
(3) claim to have made a more accurate estimate of reserves than he really has.

The actuary must clearly emphasise what he can, and what he cannot, do.

The actuary must understand the business, he must understand the data, he must try to get into the mind of the underwriter — it is so important to understand what the underwriter was thinking when he wrote the business in the first place. This involves long and detailed discussions with the underwriter and with others in the company or syndicate.

The actuary must fully appreciate the effect of reinsurance on claims that have developed or will develop. Although this can look simple at first glance, it is probably the most difficult part of working with a London Market insurer. The actuary must explain his approach in simple terms. He must extract the most distorting elements of the business, which can be latent claims, such as asbestos, pollution or silicon implants, and deal with these separately from the remaining business. He must remove the effects of large catastrophe losses, and large and unusual risks and claims have their own particular features.

Most importantly, as stressed in the paper and in the discussion, the actuary must obtain the best quality data from the insurer. He must also stand back at intervals in the reserving process, and especially at the end, and judge whether the answers look reasonable or unreasonable. Graphs can be illuminating here.

Section 5.7 sets out procedures for estimating reserves without using claims data. Clearly this is judgemental, and must be performed very carefully indeed. Using hard claims data (and using paid claims data rather than incurred claims data, if the paid data are sufficiently developed) is most certainly to be preferred.

Section 5.2 discusses the sub-division of the data. The insurer will have sub-divided the data for underwriting, for reinsurance collection and for compilation of the DTI returns and the like. However, actuaries need to group the data in a different way. We need to group it in a way that shows common future claim development characteristics, and this does not just mean smooth data. To do this, we

must consider the class and the type of business being written, the currency and the domicile, the risk being assumed, and many other features.

We must not be afraid to discard data. Using data that are unsuitable for the future projection of claims will be completely wrong.

Uncertainty is, perhaps, the most important element that sets actuaries aside from other professions. Sensitivity analysis is essential to understand the effects of different future claims developments. We must appreciate the effect of a variety of results about the best estimate on the bottom line of a company's results.

We must also consider the effect of external factors. Claims payments could be held up in broker offices or delayed by insurers in run-off. We must understand what is happening, and allow for these factors in the claims projection.

The role of the actuary is widening. Actuaries are involved in reinsurance assessment, general profitability, and are far more involved than ever before in pricing. This must be encouraged by the Institute of Actuaries by increasing the educational content of the examinations. We should not leave it to individual actuaries to learn this by chance in the outside world.

Several speakers talked about achieving a balance between simplicity of approach and statistical soundness and sophistication. It is all too easy to get involved in statistics and to leave aside the real world of poor quality data. Often we should leave aside the calculations and look at the basic increments of the data. It is possible to learn more by rearranging and manipulating the data, than by using advanced mathematical techniques, and it is much easier to explain.

The role of the auditor was mentioned briefly. It is important that the actuary knows what the auditor does, and does not, do. Conversely, auditors must learn exactly what actuaries do. Unfortunately, we do not meet to discuss what we are doing in different fields, and this is an area that we must rectify in the future if we are to secure a crucial role in the running of a good insurance company or Lloyd's syndicate.

Chain ladder and link ratio techniques must not be used blindly, because of the possibility of changes in the mix or the profile of business. Single underwriting year assessment can supplement this approach and highlight the development of claims. Curve fitting is also helpful as a test of the reasonableness of the data.

Documentation is easily overlooked, but thorough documentation is important. It can also be so helpful in producing a final report.

Companies are moving away from the traditional three-year accounting method towards a one-year approach. This introduces many complications, such as the effects of risk attaching policies, where business not even on the books will now fall within the future reserves. There is a vast learning exercise for the management of London Market companies and Lloyd's syndicates. Who is better equipped to be the teacher than the actuary?

Our level of research and development has been of considerable benefit to actuaries in the London Market. It is vital that we continue our efforts within the Institute, The London Market Actuaries Group and the General Insurance Study Group.

The President (Mr C. D. Daykin, C.B., F.I.A.): Reserving is, indeed, a critical area for general insurance actuaries, where the need for actuarial involvement is increasingly being recognised; nowhere more so than in the London Market. Here the long tail of the business and the uncertainty and variability of the underwriting and claims processes present particular challenges to the setting of reserves. Case reserves, as traditionally used, are an inadequate guide to the ultimate outcome. Simple extrapolation methods are not sufficiently robust. Statistical methods often give a spurious impression of accuracy or the ability to measure uncertainty. So, it is necessary to use a range of different models, including those which look at exposure, at the premium rates charged, the coverage and the reinsurance programmes.

The author has helpfully set out some of the issues and some of the methodologies which may be used in this area. Others have drawn attention to the fact that there are other methods in use, and where there is a need for further research.

This paper is not primarily about methodology. It is full of warnings about how to operate as actuaries in this type of business. This message has been repeated in the comments of many speakers.

It is important to know the business and to talk to those involved in the business, as an integral part of applying any actuarial methodology.

Although we can add value through actuarial involvement, we cannot predict the outcome on this type of business, and we must always acknowledge that inevitable uncertainties exist. We must be careful not to imply that estimates of outstanding claims are predictions, or, indeed, that we can put an upper bound on the possible out-turn.

Instead, we are usually looking for an appropriate figure for a particular purpose. This may be for the accounts, for considerations of financial strength or dynamic financial analysis. It may be for monitoring performance from an internal management point of view, or it may be for informing the premium rating process. It is interesting that few speakers mentioned the need for actuarial certification or a formal statutory role in this area. Perhaps the rapid expansion of the role of actuaries in the London Market is evidence that we can add value without having such a statutory role yet in place. This may indicate that a statutory or more formal role should follow.

This is an important topic, and we are all grateful to the author for presenting his paper to us, for the valuable contribution that he has made to the literature and for the discussion which he has stimulated. We thank him for the considerable effort in producing such a paper and in bringing it to us this evening.

Mr G. P. M. Maher, F.I.A. (replying): In relation to Mr Hinton's comments, there are undoubtedly other people who understand the business; there are undoubtedly other people who are numerate; but perhaps not so many people who bring or attempt to bring these different aspects together, and frequently meet to discuss the problems of going through that process.

I also agree with a point made by Mr Craighead and Mr Jones, in different ways, about counsels of perfection. Loss reserving is a practical subject in many ways. One is the fact that the evaluation needs to be done within a month or two of the end of the year, and cannot be done over a period of years. In practice, time constraints may mean less detailed research on the data. It is often the case that, as time goes by, the evaluation of an account becomes more detailed, as there is time to go into more of the details.

Several speakers have agreed that there is a need for further practical papers, and a number of areas have been mentioned. It is sometimes valuable to look at the literature of the Casualty Actuarial Society, which very often provides solutions to problems which they have encountered in the past, solutions that are relevant on this side of the Atlantic.

WRITTEN CONTRIBUTIONS

Dr R. J. Verrall: The author is correct in stating, in the Abstract, that "The use of sophisticated mathematical techniques should not distract from the importance of understanding the business and ensuring the data are correct". On the contrary, the use of modern statistical methods greatly enhances the understanding and interpretation of the data. There is little in the paper that indicates that any methods other than straightforward triangulation methods "based on the application of development patterns to the insurer's premiums and claims" have been considered. The list of references ignores the *ASTIN Bulletin*, ASTIN Colloquia, and the *Scandinavian Actuarial Journal,* and concentrates almost entirely on *J.I.A.* and the *Proceedings of the Casualty Actuarial Society*.

For example, *Benchmarks* (Section 5.4) and the use of 'other information' for reserve estimates (¶5.7.3) appear to be ideally suited to Bayesian methods (Verrall, 1990). The segmentation or aggregation of data, in Section 5.2, could have been investigated more thoroughly using an additional factor for classes of business within a generalised linear model. If you treat all classes together and apply a chain ladder model (with a row and column effect), you aggregate data by *not including* a class effect, or segment data by *including* interaction terms. Of course, there is a very sensible model between these which just includes the main effect for class of data. The parameter values, residual estimates and graphical summaries can greatly enhance the understanding of the data.

Figure 5.5 is gratuitously misleading. It purports to show the results of 'curve fitting'. There are 4 data points, which lie exactly on a straight line. Given those, and no other information, the only

sensible curve to fit is a straight line. To fit or assess any of the plotted curves, more information is necessary, which the author has chosen not to present.

Statistical methods do not provide a solution to reserving which is guaranteed to be correct. They do not try to. Of course, understanding the underlying business is essential for a proper reserving process. The whole point is that modern statistical methods can greatly enhance the understanding of the data. The author should be arguing for greater understanding of the business through *both* an in-depth analysis of the data *and* 'discussions with underwriters, claims staff and reinsurance staff'. A shallow approach to either aspect is inappropriate.

REFERENCE

VERRALL, R. J. (1990). Bayes and empirical Bayes estimation for the chain ladder model. *ASTIN Bulletin,* **20,** No. 2.

Professor A. D. Wilkie, F.F.A., F.I.A.: I was a little disappointed by the author's dismissal of statistical techniques, which was reinforced by many speakers in the discussion. It is true that "the use of sophisticated mathematical techniques should not distract from the importance of understanding the business and ensuring that data are correct". However, statisticians are as well aware as actuaries are of the necessity of ensuring that data are correct, and understanding what the numbers mean. Statisticians are also aware of the problems of uncertainty of parameter estimates and instability of models. However, by the use of the right statistical techniques, it is possible to allow for uncertainty in parameter estimates, and also to model potential secular changes in the underlying structure. Actuaries do themselves no service by dismissing statistical techniques, or by not bothering to understand them. They are in danger of finding that competent and knowledgeable statisticans can bring more to the table than actuaries, however much the latter try to rely on 'common sense'.

The author subsequently wrote: The opener was the first speaker to mention the importance of understanding and communicating the uncertainty, and a number of other speakers expanded on this point, a point with which I am very much in agreement. We are providing estimates which are uncertain, and we need to communicate this. The greater part of this uncertainty is systematic rather than stochastic, as mentioned by Mr Ryan, and I thoroughly agree that more work is necessary in this area.

The opener and Dr Hooker also mentioned the opportunity for actuaries to add value to the rating process. In the U.S.A., actuaries are extensively employed in this area, and I am of the opinion that their employers are at a significant competitive advantage because of this invovlement. Indeed, I think it essential for the longer-term profitability of the London Market that there is more independent analytical input to the rating process, as well as to the reserving process.

I do not disagree with Mr Craighead as far as curve fitting is concerned, to the extent that he perhaps thinks. Selecting report-to-report factors is also a curve fitting process, and involves elements of smoothing. My objections to some curve fitting approaches are that they extrapolate beyond the observed data and that they are presented, in practice, as more scientific than they, in fact, are. They also differentiate years simply because of trends or apparent trends in the claims triangles. Often the reason for treating years differently is because of underwriting or other information, external to the triangle. Adjustments to development factors (as for example in the appendices) make the chain ladder method, as used in the paper, very adaptable, and incorporate most of the features of other methods. Graphs can, of course, be helpful in distinguishing features of the data, as Mr Hindley suggests.

Rate on line is, contrary to what the opener suggests, useful in distinguishing between relative risks. Higher premiums are collected where the risk is seen as higher. Of course, there are variations over time, as the market is more or less competitive, but, in reserving for a particular catastrophe, we are looking at policies at one point in time, and the distortions are not likely to be that signifcant, when the uncertainty of the end result is considered. Nothing is perfect in this market, and the imperfections should not distract from attempts to construct reasonable models. Capturing data, such as rate on line, in the model highlights (despite the imperfections in the assumptions) features of the account which are real and which would not have been seen had one abandoned the possible approach because the assumption was imperfect.

I agree with Mr Bride that the approach described in the paper for estimating unpaid claims produces an extremely complex model, although the mathematical simplicity of the triangulation analysis (which is only part of the process) may not indicate this, Many classes of business are analysed separately. Different methods are used for each class. Numerical information is incorporated, as are subjective judgements, claims and policy information, underwriting and other information. The process is more complex, in practice, than the case study indicates, and is more complicated than many of the statistical models. In the real world, things do not work out exactly as they should, and seldom do the data so clearly tell us that business changed as in my example. Seldom, if ever, do the different methods agree so closely as indicated in my examples, as Mr Malde noted. Seldom, if ever, is the agreeement of the data and the benchmark as close as we would like it to be. Nor are the legal issues always clear, and allocation of latent claims by year is seldom a straightforward matter. I intentionally presented things in a somewhat idealised way, for purposes of clarity. Many points of the process are simple in principle, but complex and time-consuming in practice.

Both Mr Craighead and Mr Jones make the point of counsel of perfection, and I thoroughly agree that we cannot be expected to get everything done at a single evaluation, particularly since data are seldom available at the level ideally required. Typically, each successive evaluation leads to more data being produced (often as a consequence of caveats included in the previous year's report) and to areas being investigated in more detail. If we do not have the data we cannot develop the models. I very much agree with Mr Craighead's comment in this respect.

I agree with Mr Larner, that other factors need to be incorporated into the rating index set out in the paper. These other elements will differ by line of business and would include wage roll, for example, for an employer's liability account or fee income or number of partners for different types of professional indemnity accounts. If, in practice, we could always assemble the data to prepare the index I present, we would have made great progress. It is, however, surprisingly difficult, as Mr Malde indicates, to get as far as I have suggested. This is one of the problems with reserves for a number of companies and syndicates, who cannot track overall underwriting changes at a level suitable for reserving purposes.

In connection with Mr Hindley's comment about finding the data to test the changes in the underwriting of the account, I am not simply thinking of number of claims data, and I do not think that one can generalise. The additional data depend on the precise reason for the change in assumptions; it could be policy wording, details of non-renewals, details of attachment point, underlying exposures, or whatever.

In practice, many of the techniques, to which Professor Wilkie refers, unfortunately do not add to the process, and it is, perhaps, therefore not surprising that the apparently more straightforward triangulations are the stock-in-trade of most practitioners in the U.K., the U.S.A. and other countries. Indeed, some of the statistical techniques are flawed, in that the models involve the fitting of curves to the data to extrapolate beyond the observed experience, in other words to derive the tail factor. The process is analogous to taking mortality data for ages 1 to 10 and deriving mortality rates for ages 11 to 40, and some of the business is that long tailed. To my mind, this is an unscientific and potentially dangerous method for deriving tail factors, which can often be the most significant element in reserves and uncertainty, as Mr Larner noted. Statistical methods do not produce a satisfactory method for the tail, unless a benchmark is used for extrapolating beyond the data. Of course, if no external data are available, some allowance needs to be made, and simple graphical derivation is often as appropriate. The nature of the approximation must be highlighted and understood by the recipient of the actuarial analysis. Indeed, the fact that the simple graphical method is crude is an advantage, since the assumption is not given more scientific appearance than it merits, and the uncertainty is more apparent.

Given that the statistical packages do not provide any help for the tail, the only area in which they provide assistance is for curve fitting on the body of the triangle. It does become an interesting question as to whether involved mathematics is required to examine these data. Selecting development factors based on a review of a historic report-to-report factors, identifying anomalous features and adjusting for these (after discussing with underwriters or claims handlers, as appropriate) achieves much the same purpose. Detailed statistical models only add value if the underlying assumptions are valid, which is almost invariably not the case for business written in the London Market. This is

particularly true since nothing ever stays the same. There are, therefore, generally few data points related to similar types of business, which is one of the reasons why understanding the business (a far more complicated process in this market than understanding the data) is so important.

Indeed, some of the statistical packages on the market make the loss reserving process apparently more straightforward than it actually is. I have heard one approach being sold on the basis that the model made reserving for a line of business possible in five minutes. The actuarial approach, which is superficially more simple, is often (or invariably) more complex in practice.

Dr Verrall suggests that a generalised linear model with an additional factor for classes of business can be used to allow for class differences. I do not think it is that simple. The classes of business are separated because the business is different, sold in different markets, subject to different risks and so forth. It may well be the case that the claims data do not appear to differ, for various reasons, sparseness of the data, erratic claims development, limited history or whatever. The fact that there is no apparent difference in claims development is irrelevant if the classes may go through different pricing changes, different underwriting cycles or if they are affected by different factors. It is a matter of indifference as to whether or not the professional liability and pharmaceutical classes show statistically indistinguishable development (which is not impossible in some cases). The business is different, and must be analysed separately, unless the data are not available or the business is so small as to be allocated to the miscellaneous class.

Figure 5.5 is far from gratuitously misleading. This is a very typical case. The point is that fitting any curve through four points in order to extrapolate the future is an error, and other information must be found. In my experience, curve fitting techniques are applied precisely in the situation described. The point is as true (although less obviously so) if there are some more data points which appear to indicate lower development. Again, it is possible to generate a wide range of answers, each based on a different curve, each giving a good fit. Less obviously, when the development appears to have reduced, but just as important, is to look at the underlying exposures, as described in the appendices.

I do not, however, wish my comments on the difficulty of developing and applying appropriate statistical modeling to the London Market and my comments on the applications of these models in practice to be taken as a more general criticism of statistical models. That is not my view. There are many areas in which these techniques are essential for actuarial analyses, including risk relativity review or reinsurance rating, to give two examples. In fact, ¶5.13.2 makes the point that stochastic variations may need to be considered, which requires statistical analysis. Nor are my comments to be taken as indications that these approaches do not generally assist in reserving. We must, as Dr Hooker said, continue to build on the foundations that have been laid, while maintaining a practical outlook. The point of my paper is not to devalue statistics (which would be to devalue what I do), and misunderstanding this point may be a reason for the comments of both Professor Wilkie and Dr Verrall. I am in complete agreement with Dr Verrall that a shallow approach to understanding the business and understanding the data is inappropriate for rendering a professional opinion.

However, much of actuarial reserving theory tends to be concentrated on yet further, and often more detailed, approaches to reviewing data. I am of the opinion that the many other areas involved in assessing reserves could benefit from further theoretical work. These areas include, from the London Market perspective, asbestos, pollution, catastrophe exposure modelling, incorporating pricing information, modelling uncertainty and risk-based capital requirements, amongst others. There are also a number of market problems, such as reserving for losses for certain line slips, which could also be usefully covered. Actuarial research in these areas requires input from many non-actuarial sources, including statisticians, lawyers, the medical profession, underwriters, claims handlers specialising in the relevant field, meteorologists and reinsurance specialists, amongst others, and would benefit the profession.