REPORT OF THE

WORKING PARTY

ON

CLAIMS RUN-OFF PATTERNS

presented to

General Insurance Study Group

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<u>Note from the Chairman of the Working Party on</u>
<u>Claims Run-off Patterns</u>

Because of an error in the program discovered at a late stage, the results for the average claim method on the two motor risk groups were slightly *wrong* and *were* therefore omitted. Revised tables and graphs will be distributed. In the meantime please note that tables 23, 24, 31, 32, 40 and 46 are missing from Section C and that tables 49 and 50 are incomplete. Similarly graphs 11 and 12 in Section D each omit one curve.

P.H. Hinton
26 September 1989

SECTION A
Summary and main conclusions

A1 Structure of report

A1.1 Section A contains the background to this report (A2, A3), and description of the data analysed and their limitations (A4-A5). Note the qualifications in A5.2. It then goes on to indicate how the data were analysed and the main assumptions made for this purpose (A7-A11). Observations from our analysis of the data and our conclusions are presented in paragraphs A12-A18. A19 contains suggestions for further research.

A1.2 Section B describes in some detail the analysis of the claims data to obtain the run-off patterns.

A1.3 Section C contains tables showing the run-off patterns, mean terms and some sensitivity analyses.

A1.4 Section D contains graphs showing some of the run-off patterns and the variation between companies.

A1.5 Section E describes the use of the stochastic chain ladder to derive both a payment pattern and its standard error directly from the payments triangles.

A2 Terms of reference

Following the comments on our interim report, presented to the GISG Conference in October 1988, we amended our terms of reference. The amended terms of reference are:

> The working party will examine the claims run-off patterns, for gross amounts of claim, of a number of insurance companies for UK private motor, employers liability and fire business using run-off data from DTI returns. The effect of adjusting for inflation on the run-off patterns will be examined. The aggregate data will be examined for changes in run-off pattern. The use of standard tables to discount outstanding claims will be considered. Recommendations for further work will be made.

A3 Origin of Working Party

A3.1 Following the GISG Convention in Torquay in October 1987 this working party (the CWP) was set up to examine claim run-off patterns. This followed a suggestion in a paper on the discounting of general business claims reserves. It suggested that standard payment patterns might be appropriate for discounting claims reserves in certain circumstances. Alternatively standard patterns might be used as a starting point against which a company's experience could be assessed. It was suggested that these possibilities be investigated further.

A3.2 The CWP made an interim report to the General Insurance Convention in Harrogate in October 1988. A number of suggestions were made by the Convention. These included: the examination of a property risk group in addition to Private Motor and Employers Liability; the search for time trends; and the presentation of some results graphically.

A4 Data

A4.1 All the data examined came from Forms 33 of the returns which have to be made to the Department of Trade and Industry (DTI) by companies authorised to write business in the UK. Forms 33 (and for 3 year business Forms 35) constitute the most comprehensive set of claims run-off data available for UK companies.

A4.2 Subject to certain de minimis exceptions, the direct (and facultative reinsurance) business carried on by UK authorised insurance companies must be analysed into risk groups and the run-off of the claims of each risk group presented in Forms 33 (or 35). A risk group comprises risks constituting part of the business carried on in any one country within any one of the 8 DTI accounting classes, "which, in the opinion of the directors, are not significantly dissimilar either by reference to the nature of the objects exposed to such risks or by reference to the nature of the cover against such risks given by the company".

A4.3 The intention was that risk groups should be relatively homogeneous so that the run-off could be expected to be reasonably stable, but the definition is broad enough to permit considerable heterogeneity. Thus run-off patterns might be expected to vary considerably between different companies and within companies from year to year.

A4.4 It should be noted that from 1981 UK "home foreign" business has been treated as written in a different country from other UK business for the purpose of risk group definition. Thus for UK business currency movements should not distort the statistics. From 1981 also private motor has had to be distinguished from other motor business and comprehensive private motor distinguished from non-comprehensive.

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A4.5   All the data related to UK business.   The risk groups examined were Employers Liability (EL), Comprehensive Private Motor (Comp), Non-comprehensive Private Motor (Non-comp), and Fire.   Most companies did not distinguish between Comp and Non-comp for years of origin prior to 1981, and the Comp/Non-comp data were supplemented by Private Motor data for these years of origin.   Data from those companies that did distinguish between Comp and Non-Comp before 1981 suggested that, from the fourth year of the run-off (ie if years 0-2 are omitted), the claims run-off patterns for the two risk groups were very similar. Indeed there were no consistent differences and intercompany variation was at least as great as the differences between Comp and Non-comp.

A4.6   Data from a limited number of companies were examined, to restrict the amount of work and data to manageable proportions. Much of the data came from the DTI computer database by a tortuous route.   Not all the data were checked against the original returns by the CWP.   Full data relating to payments before 1981 were not readily available and this complicated our analysis.

A4.7.   The Form 33 data are gross in that they make no allowance for reinsurance recoveries (but subrogation recoveries and salvage are treated as negative claims payments).   Run-off patterns deduced from our data are therefore not immediately applicable to a net (of reinsurance) run-off.   The CWP would, in general, expect a net run-off to be shorter than a gross run-off, partly because reinsurance recoveries relate mainly to the larger claims which may by their nature take longer to settle, and partly because of the time taken to make reinsurance recoveries.

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A5 Data discrepancies

A5.1 As a data check, box 19.3 of Form 33 (payments in previous years of run-off) in each year's returns was compared with the sum of boxes 19.2 (payments in the year) and 19.3 of the previous year's returns (or with column 5 of Form 300 for the 1980 returns).

(a) discrepancies of £1,000 were assumed to be rounding errors; boxes 19.3 were ignored.

(b) discrepancies between 1980 and 1981 returns were resolved in favour of the latter on the grounds that the likely explanation was a change in the risk group.

(c) many apparent discrepancies were due to the consolidation of a subsidiary's business for the first time. These were treated by adding the subsidiary's business to the earlier returns, except that in two cases some estimation was required due to erroneous and incomplete data in the returns.

(d) in one case a block of business, which had been reinsured with the company and included in the returns as if the business were its own, was subsequently excluded. Pro rata adjustments were made to the data from the earlier returns.

(e) one company featured matching discrepancies which arose in one year's returns but were cancelled out by discrepancies of the same size and opposite sign in the following year's returns. Another company had matching discrepancies between its comp and non-comp risk groups. In both cases the later returns were assumed correct.

(f) one company featured large discrepancies in its EL business which on enquiry it explained as due to a reallocation of disease claims between years of origin. These, and other

smaller unexplained discrepancies in the same risk group, were treated by assuming that the latest figures were correct and rating the earlier figures up or down accordingly. This company also had a number of discrepancies in its motor and fire risk groups. As there was no reason to treat these the same way, the payments figures were assumed correct.

(g)   there was a single discrepancy between successive returns concerning claims paid in the year of origin. In this case the later return was assumed correct.

(h)   after eliminating the discrepancies in (a)-(g), only ten of those remaining exceeded £10,000 and none exceeded £100,000. For these discrepancies an attempt was made to discover the source of the error. If this failed the payments figure (box 19.2) was assumed correct, on the grounds that one figure was more likely to be wrong than two or more.

A5.2   The existence of the discrepancies described above should be recalled and suitable caution adopted before drawing conclusions about individual companies from the run-off patterns presented.

A6 <u>Numbers</u>

We considered analysing run-off patterns of numbers of settlements as well as run-off patterns of payments. However office procedures affect the definition of what constitutes a claim and when the claim is regarded as settled. Payments to (or on behalf of) the insured to cover his losses are the purpose of an insurance contract and thus <u>the</u> important statistics. Also we considered them (for this very reason) less likely to be affected by operational changes. Since run-off patterns of claim amounts are those relevant to the questions of discounting, which

led to the formation of this working party, we did not proceed with any analysis of the run-off of claim settlement numbers.

A7 Tail factors

A7.1   Tail factors were obtained by averaging from company estimates for the three earliest years (75-77 or, for fire, 81-83). They assume that the company estimates are correct, are not discounted (explicitly or implicitly), and make full allowance for future inflation. To the extent that these assumptions are incorrect, the tail factors are wrong.

A7.2 The particular procedure adopted can give somewhat peculiar results when payments in the last two years of the run-off are compared with payments thereafter.   Because only a small proportion of the liabilities is paid at these durations, this possibility was not considered of concern. See however A12.4.

A7.3   Last year when displaying run-off patterns we excluded from the denominator expected payments after the twelfth (sixth for motor) year of run-off. An analogous procedure has not been followed this year, partly because it was thought that at the longer durations the estimates would be largely based on real features of each company's data and therefore should not be excluded and partly because the amount in the tail is less than last year, when only six years data were presented for motor. For the purpose of comparing different run-off patterns, the current presentation is felt easier to use.

A7.4   For both the employers liability and the fire data the working party noted considerable variation between companies in the proportion of claim amounts outstanding at the end of the run-off periods examined (ie after 13 or 7 years).

A7.5 In the case of fire, large risks may be double-counted if they are reinsured facultatively. This was noted as a possible source of distortion.

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A7.6   An alternative approach to the tail, which we did not adopt, is to fit a curve to the run off. This avoids having to use company estimates of outstandings, but risks cutting through real features of the data. Where the data include, for instance, industrial disease affecting a number of years of origin simultaneously, then curve fitting methods are more likely to be successful if the industrial disease claims are analysed separately, which we cannot do from public data.

A8 <u>Mean terms</u>

A8.1   The working party considered that the mean term of outstanding claims provided a simple and powerful means of consolidating the length of a run-off pattern into a single figure, though clearly the mean term cannot indicate all the features of a particular run-off pattern. Knowledge of the mean term would enable the approximate impact of discounting to be estimated (though choice of run-off pattern given the mean term can sometimes materially affect the result of discounting).

A8.2 We assumed that all payments were evenly spread throughout the year in calculating the mean terms in Section C. This is of course an oversimplification, and it was noted that certain companies make other assumptions in their own analyses. However for the particular purpose of inter-company comparisons it was not thought that this assumption was likely to cause serious distortions.

A8.3 Assumptions were necessary regarding the mean terms of the tails of the available run-off patterns. It would have been possible to fit curves to the run-offs and from these to estimate mean terms for the tail. However we considered that the results were likely to be of doubtful accuracy and might introduce spurious differences between companies. We thought it preferable to make an arbitrary assumption, rather than to use a more sophisticated procedure of dubious accuracy.

A8.4 We assumed for the tables in Section C that the mean term of outstanding claims was four years for employers liability at the end of the thirteenth year, two years for both of the motor risk groups at the end of the eleventh year and two years for fire at the end of the seventh year. The effect of alternative assumptions on the mean terms of the aggregate data is shown. In most cases the precise assumption about the mean term of the tail of the distribution would not have a great effect when discounting.

A8.5 A particular indicator we considered would be useful was the overall mean term of a company's claims liabilities. This would normally be an average weighted by the amounts outstanding at the various durations. However amounts outstanding reflect changes in the size of the account. As our main interest was in the underlying pattern the weights used instead were the proportions outstanding based on the run-off pattern. Thereby inter-company comparisons are not distorted by changes in the relative sizes of accounts.

A9   **Estimation of run-off patterns**

A9.1 The problem of estimating run-off patterns from a set of run-off data is most commonly met in the context of the estimation of outstanding claims or the validation of an outstanding claims provision. Most statistical methods of estimating outstanding claims generate, implicitly or explicitly, an assumed run-off pattern.

A9.2 The CWP used four methods of estimation. Three are familiar in the context of outstanding claims estimation/verification: basic chain ladder, inflation adjusted chain ladder and an average claim method. The fourth was an ad hoc method based, inter alia, on the assumption that a company's outstanding claims estimate was correct (this seemed appropriate in the context of discounting a claims provision, since it

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produces a run-off pattern consistent with the company's adopted provision).

A9.3   The methods are described in more detail in Section B. Section B also describes the adjustments to the methods to use the private car motor data for years of origin prior to 1981 to extend the run-off pattern to the right.

A9.4   Objections have been raised to using chain ladder methods mechanically for estimating the quantum of outstanding claims from data on paid claims. The most significant objection is that data fluctuations can make the estimate unstable. The CWP were however primarily concerned with the use of the patterns to allocate claims between years of payment, eg for the purpose of discounting.   In this context such objections have much less force.

A9.5   The run-off patterns presented are those appropriate to such an allocation between years of payment.

A10 <u>Inflation</u>

A10.1   The index of average earnings (Department of Employment index, all employees, June value) was used in the inflation adjusted chain ladder and average claim methods for EL and motor. This was thought to be the most suitable index for EL, and to be a reasonable index for motor.   For the Fire risk group, the construction output index of producer prices, published in the CSO Monthly Digest of Statistics, was used. The run-off patterns presented for the IACL and AVC methods assume inflation of 8% throughout in line with our working assumption about future inflation.

A10.2   For the IACL and AVC methods it was necessary to make an assumption about the assumption made by companies about future inflation when setting claims reserves.   The 8% inflation assumption is the same as in our 1988 report.   There it was

explained as being essentially arbitrary but a not unreasonable assumption to make in the early part of 1987, when the 1986 returns were being finalised. Thus the 8% assumption was thought to be reasonably consistent with most companies' claims estimates.

A10.3 We did not consider that the situation when the 1987 year end figures were being finalised was sufficiently different from that a year earlier to warrant changing the 8% assumption for our present report. Since then inflation has accelerated and if we were using 1988 data an higher inflation assumption would probably be appropriate.

A11 <u>Statistical variation</u>

A11.1 It is well known that stochastic variation can lead to quite large differences between one set of run-off statistics and another. This is particularly the case for gross claims run-offs, where single large claims can be significant.

A11.2 It is not possible to assess the effect of statistical variation without some sort of statistical model. This caused us some difficulty in our previous report, where we presented a number of standard deviations but could not describe how they could be used to draw conclusions in anything like a rigorous fashion.

A11.3 For this report we have investigated the use of the stochastic chain ladder model which is now covered in the Institute's Claims Reserving Manual, Vol. II. We have used this to derive payment patterns and their associated standard errors. The details of both the assumptions and the calculations are to be found in Section E of this report.

A11.4 The advantages of such models are still to be fully explored. Apart from testing the goodness of the fit and identifying outliers or data that need to be investigated, such

models can be used to consider whether there is evidence of run-off pattern changes over time, to test for superimposed inflation or the appropriateness of an index, and also to look for single measures that may be related to stochastic variability and so facilitate inter-company comparisons. Some preliminary work along these lines is presented in Section E.

A12-17 Observations on Tables

Except, where otherwise stated these are based on the inflation adjusted chain ladder.

A12 Fire

A12.1 In almost all cases 90%, and for rather more than half the companies 95%, of claims payments are made by the end of year 2. With one exception, for all companies where payments in 1981-87 exceed £100m, between 47% and 54% of payments are made in year 0. There is much greater variation in this proportion for the smaller companies.

A12.2 The mean term at the start of year 1 ranges from 0.6 to 2.0 years. If allowance were made for the uneven incidence of claims payments within individual years they would presumably be even lower.

A12.3 In a large proportion of cases there are net negative claims payments in years 4-6 and some companies (see company incurred table) anticipate net recoveries thereafter although the data are gross of reinsurance.

A12.4 Anticipated payments after year 6 are generally quite small with some exceptions. It was noted that as a proportion of total claims payments these payments showed considerable variation. For many companies and overall, the anticipated payments seem large having regard to the pattern of payments in years 4, 5 and 6. (This may mean that for these companies and

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overall, the mean term of 2 years assumed for claims outstanding at the start of year 7 is too low. But this feature may well be connected with the negative payments which we did not understand. Also it may arise in part from the way tail factors were calculated, cf A7.2. We therefore did not alter the assumption of a 2 year mean term at duration 7, which assumption in any case has little effect on the pattern derived for the IACL and AVC methods and limited effect on the overall mean term. Nor was it possible in the time available to consider modifications to the method of deriving tail factors.)

A12.5   More detailed examination of the data indicated considerable variation in run-off patterns between years of origin for any one company. Thus part, but not all, of the observed variation between companies (see graphs 2 and 6) may be ascribed to stochastic variation.

A12.6 We thought that those companies without a household (or equivalent) risk group might include household business in their fire risk group. If so, we expected these companies to exhibit a faster run-off. No such effect was observed.

A12.7 While the construction output index of producer prices was used as the inflation index in the IACL and AVC methods as likely to be more appropriate than the earnings index, it is of interest to note that we were not able by detailed examination of average claims to demonstrate this or even that the earnings index was inappropriate. Though such examination did suggest that claims inflation was less than would be expected from the earnings index, the effect was small compared to variation from year to year and was of no statistical significance.

A13 Employers Liability

A13.1 This is a long tail class with 3% of claims payments made in year 0 and only around 40% by the end of year 2. As long tail classes go it is quite short: only about 12% of claims remain outstanding at the end of year 6. Nevertheless, at the end of year 12, over 2% of payments still have to be made and for a number of companies the amounts are material.

A13.2 The variation between companies (see graphs 1 and 5) is considerably lower than for fire business. This is the case even though two companies account for some 45% of the claim payments and others have very low volumes of data. Similarly, the variation between years for a company is much lower. However there was considerable variation in the proportion outstanding after year 12.

A13.3 The raw run-off patterns for some of the smaller companies are very irregular and need smoothing. For these companies we could not infer that the overall pattern was inappropriate.

A13.4 Mean terms at the start of year 1 range from 2.7 to 4.2 years. They generally increase fairly smoothly with duration.

A13.5 At all durations, payments in 1987 were much greater than expected by comparison with earlier year payments. This would in particular include an unusually large year 12 payment and the increase between year 11 and year 12 proportions is no doubt largely the result of this calendar year effect.

A13.6 Stochastic variation accounts for much of the observed inter-company variation in run-off patterns. However, the analysis using the stochastic model shown in Section E indicates that there were real differences between companies.

A14 Private Car Comprehensive

A14.1   About 60% of claims payments are made in year 0.
Thereafter the run-off is slower than for fire with 83-92% paid
in years 0-2. Less than 2% overall is outstanding after year 6.

A14.2 The mean terms at the start of year 1 range between 1.3
and 2.0 years.

A14.3 The run-off patterns in the early years are extremely
uniform (see graphs 3 and 7). In the later years of the run-off
there is more variation, thought largely the effect of a few
large claims.

A14.4 Mean terms to settlement appear quite stable.

A15 Private Car Non-Comprehensive

A15.1 About 30% of payments are made in year 0. 55-78% are paid
in years 0-2. Overall less than 5% is outstanding after year 6.

A15.2 The mean term at the start of year 1 ranges from 2.0 to
2.8 years.

A15.3 Run-off patterns are much more variable than for Comp.
(see graphs 4 and 8). This is to be expected from size
considerations alone since even the largest accounts are small
compared to the large Comp accounts.

A16 Overall

A16.1 The run-off pattern for each individual company varies
only marginally as a result of different methodologies employed
in deriving the run-off pattern itself (see graphs 9-12). In
some cases, but not for the aggregate, the company incurred
method gives rather different results because of the greater
weight given to the company's adopted provisions. The CWP

considers it unlikely that more sophisticated techniques will provide any significant improvement in the results obtained.

A16.2 The assumptions made as regards the mean term of the tail of the run-off have little overall effect. Examination of the effect of varying them on the aggregate data suggests that these assumptions are reasonable, except perhaps for fire.

A16.3 The mean term to settlement for the risk groups examined seldom rises above 4 years, even for the EL data which is clearly much the longest tail risk group considered, unless we have significantly underestimated the length of the ultimate tail.

A16.4 The differences in observed run-off patterns and particularly in mean terms between companies are sufficient to have a material effect if used to discount reserves.

A16.5 The data analysed relate to the past. There may have been changes in the nature of the business written by, or other developments at, individual companies which make their historical experience of limited value in assessing future developments. A similar comment applies to the market as a whole.

A17 Other points arising from examination of data and tables

A17.1 Small and very small risk groups often provide run-off patterns which are unduly affected by exceptional incidents and which appear unreasonable on intuitive grounds alone. However, even the largest insurers in each risk group may have to adjust their data in order to produce patterns which seem reasonable.

A17.2 There is (with a few exceptions) little variation in the run-off patterns between the biggest insurers but considerable variation from the mean for a number of smaller companies. These companies would have to consider carefully to what extent their divergence from the market is intrinsic to their methods of operation or selection of risks and to what extent it can be

ascribed to chance. Even for intrinsic divergences they would have to consider whether the causes are likely to persist. It is the opinion of the CWP that only part of the variation between companies can be regarded as stochastic. The remainder must then be regarded as intrinsic.

A17.3 From the data there was no reason to believe for Fire and Non-comp that the run-off pattern was in any way affected by the amount of business written by the company in the risk group. Regression analysis of run-off proportions against the logarithm of size (as defined in the index to section C) showed that for the companies in our sample the proportion paid in years 0-2 for EL and years 0-1 for Comp increased with the size of the account. Although this analysis did not take account of differences between companies in the variability of the parameter tested (cf Section E), it did provide a strong indication that differences were not due simply to chance. It will however be seen from graphs 13 and 15 that the differences are quite small. It is not possible to infer from the data whether the observed differences are due to claims settlement procedures or the selection of risks.

A17.4 In A12.4 we noted that there was for Fire considerable variation between companies in the proportion of claim amounts outstanding at the end of year 6. The CWP thought that one cause of this was fluctuations arising from individual large risks (in which case inter-company variation of amounts outstanding would be very much less after reinsurance).

A17.5 A large proportion of the late payments noted in 13.1 is likely to be due to latent disease (e.g. asbestosis) or industrial deafness. We thought that the presence or absence of exposure to these types of claim was one factor that might account for the variation between companies in the size of the extreme tail. If such claims can be expected not to recur or can be expected to be recognised sooner, the data may need to be adjusted before the run-off pattern could be used to prepare

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cash-flow projections for outstanding claims. (But if other, and possibly new, types of industrial disease should affect claims the run-off pattern may not shorten in future). Industrial disease was also noted as a possible source of distortion in the statistics since there is no uniquely correct way of allocating degenerative industrial disease claims to a year of origin.

A17.6 Some changes to motor run-off patterns might be expected from changes in seat belt legislation, and from changes in public attitudes to seat belt usage which both prompted the legislation and were later encouraged by it. These can be expected to have led to a reduction in injuries and have also led, where seat belts have not been worn, to reductions in claim payments on account of contributory negligence. The effect on the payment pattern of a 10% reduction in all payments made after the end of year 1 is shown in the next paragraph.

A17.7 Run-off patterns for motor are:

	0	1	2	3	4	5	6	7+
Comp								
Observed	625	239	39	34	24	15	10	14
Adjusted	634	242	36	31	22	14	9	13
Non-comp								
Observed	286	252	132	113	83	53	33	48
Adjusted	300	264	125	107	78	50	31	45

The observed patterns are obtained from the IACL on the aggregate data. The adjusted patterns are obtained by assuming a 10% reduction in payments in years 2 and later. (The data include payments which are assumed to be affected by the seat belt change, but this data has not been adjusted, since the overall effect would be much the same.)

A17.8 The data were examined for secular changes in run-off patterns. Strong evidence for a change in pattern of the kind expected from the seat belt change was found for Comp. The Non-comp data also demonstrated such a change but the evidence was weaker: the data were more variable (owing to fewer claims). There was evidence for other changes in run-off pattern for Comp with the run-off being quicker, perhaps a result of the trend to NCD protection.

A17.9 Paragraphs A17.1,2,5,6 above illustrate an important point. The actuary (or any other person) making claims estimates, including estimates of the effect of discounting, needs knowledge of the business written and of changes in the market. The blind use of statistics or other data without considering the circumstances under which they arose or the underlying reality to which they relate, is highly dangerous.

A18   Use of Standard Tables

A18.1 We have already commented (A17.2) that there are, in the opinion of the CWP, intrinsic differences between companies. Furthermore, these differences can (A16.4) materially affect the result of discounting claims. However, these differences can be masked or overshadowed by differences arising from what may be regarded as stochastic variation (A17.1 and A17.2).

A18.2 Under these circumstances the use of standard tables to discount claims, or for any other purpose, without adjustment is, we consider, inappropriate in general. We do, however, consider that standard tables might be useful to provide a standard against which a company's own data can be assessed. The results should be interpreted having regard to the nature of the company's business and how it differs from the market as a whole, and having regard to changes in the company and the market as a whole.

A18.3   In particular, regard would have to be had to the company's reinsurance arrangements and their effect on its run-off pattern. This effect can vary from year to year with the reinsurance arrangements and, particularly where there is whole account protection, with the company's claims experience. In general, the effect of reinsurance may be to shorten the mean term of claims, particularly if account is taken of the time taken to effect reinsurance recoveries. However, this is not always the case.

A18.4   Notwithstanding this background, there may be circumstances where, either because accuracy is not a pre-requisite or because a company lacks meaningful data, it may wish to use standard tables to discount claims, while appreciating the errors that could result.

A19 Suggestions for further research

A19.1   Run-off patterns might be examined on a quarterly or monthly basis. The effect of reinsurance and of different types of reinsurance on run-off patterns is of importance. Both these could be researched only if access were available to internal company data.

A19.2   More companies and different risk groups need to be examined.   At the very least our results should be updated regularly to include data for 1988 and, as they become available, later years. The Chairman hopes to carry out further work on these lines, given the necessary resources.

A19.3   More work needs to be done into stochastic models for claims run-offs and the examination of our data using such models.

A19.4   Simulation could in particular be used to assess the
significance of differences between individual company run-offs
and the market average and in particular the significance of
variations in mean terms.

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SECTION B

Calculation of run-off patterns

B1 Fire: Basic Chain ladder (BCL)

B1.1   The data are payments in each year 1981-87 and the company's outstanding claims estimates as at 31.12.87, for each of origin (ie year of occurrence of claim) 1981-87.

B1.2   Cumulative payments were calculated and from these the standard chain ladder rations $r(0),..,r(5)$ were formed (ie the link ratios were averaged, using the cumulative payments as weights). The tail factor $r(u)$ was calculated as the arithmetic average of the following three ratios for the years of origin shown:

   (1981) total claims (ie paid + outstanding) / paid claims;
   (1982) total claims / paid claims / $r(5)$;
   (1983) total claims / paid claims / $r(4).r(5)$.

B1.3   The ratios $r(0),..,r(5)$, $r(u)$ then define the run-off pattern.

B2 Fire: Inflation Adjusted Chain Ladder (IACL)

B2.1   The data were the same and the method similar except that the payments were adjusted to 1987 values by multiplying by the ratio of (construction output) index values for 1987 to that for the year of payment, before calculating cumulatives.

B2.2   The calculation of the tail factor $r(u)$ was more complex and took the company's estimate to be an undiscounted money estimate. In the expressions below: PAID is cumulative paid at 1987 values; $r(4)$ and $r(5)$ are as for BCL but calculated using indexed payments; $R(5)=1.08(r(5)-1)$;
$R(4)=1.08^2(r(5)-1)r(4)+1.08(r(4)-1)$; $F=1.08^{2.5}$: F adjusts 1981 outstandings at the end of 1987 to 1987 values - as payment is assumed to be on average 2 years after end 1987. $r(u)$ was

estimated as 1 + the arithmetic average of the following three
ratios:

    (1981) outstandings / PAID / F;
    (1982) (outstandings - PAID.R(5)) / PAID.r(5) / 1.08F;
    (1983) (outstandings - PAID.R(4)) / PAID.r(4)r(5) / 1.08^2F.

B2.3 The ratios r(0),..,r(u) then define the indexed run-off
pattern. The patterns quoted were to be those appropriate to an
8% inflation assumption, so the following payment ratios were
used: 1, 1.08(r(0)-1), .., 1.08^6r(0)..r(4)(r(5)-1),
$1.08^{8.5}$r(0)..r(5)(r(u)-1).

B3 Fire: Average Claim Method (AVC)

B3.1 The data include also number, N(Y), of claims as estimated
at the end of each year of origin, Y. Average payments per claim
in 1987 values were calculated at each duration for each year of
origin as claim payments in the year at 1987 values (calculated
as in B2.1) divided by N(Y).

B3.2 The arithmetic averages, A(0),..,A(6), of these quantities
defined the indexed run-off pattern to year 6. A(u) was then
defined as the arithmetic average of:

    (1981) outstandings / N / F
    (1982) (outstandings - 1.08A(6).N) / N / 1.08F;
    (1983) (outstandings -1.08A(5).N-1.08^2A(6).N) / N / 1.08^2F.

B3.3 The patterns quoted are those appropriate to 8% inflation,
and so use payment ratios of
A(0), 1.08A(1), .., 1.08^6A(6), $1.08^{8.5}$A(u).

B4 Fire: Company Incurred Method (CI)

B4.1 The data were precisely that specified in B1.1. For each
year of origin the payments in each year of run-off were
expressed as a proportion of the total incurred claims (ie total
payments to end 1987 plus outstandings).

B4.2 This triangle of ratios $r(Y,n)$ (Y is year of origin, n is year of run-off, $Y+n<1988$) was extended to complete the square $n<7$, working from left to right, using the formulae $r(Y,n)=o(Y,n-1).f(n)$ and $o(Y,n)=o(Y,n-1)-r(Y,n)$. In these formulae, $o(Y,n-1)$ is the proportion assumed outstanding for year of origin Y at the start of year n of the run-off; ie $o(Y,n-1)=1-r(Y,0)-...-r(Y,n-1)$. $f(n)$ is the sum (over Y) of the given $r(Y,n)$ divided by the sum of the corresponding $o(Y,n-1)$.

B4.3 Then the run-off pattern consists of the arithmetic averages (over Y) of $r(Y,0),..,r(Y,6)$, $o(Y,6)$.

B5 Employers Liability (BCL)

B5.1 The data were payments in each year 1981-87 and the company's outstanding claims estimates as at 31.12.87, for each year of origin 1975-87; and cumulative payments to the end of 1980 for the years of origin 1975-80.

B5.2 The calculations were as described in B1 except that care was needed in calculation of the $r(i)$ owing to the missing cumulative payments. The tail factor was calculated by averaging over the 3 years 1975-77, using $r(10)$ and $r(11)$ in place of $r(4)$ and $r(5)$.

B6 Employers Liability (IACL)

B6.1 The data were as in B5. B2 largely indicates how the calculations in B5 were modified, but the earnings index (June value) was used in place of the construction output index. In the calculation of $r(u)$, $F=1.08^{4.5}$.

B6.2 For the purpose of indexing cumulative payments to the end of 1980, the IACL was used in reverse. The following indicates the procedure. Payments for the 1979 year of origin were assumed to be split between 1979 and 1980 in the ratio $I(79):I(80).(r(0)-1)$, where I denotes the relevant index value

and r(o) was derived from years of origin 1980-86. This enabled the 1979 data to be used in the calculation of r(1), r(2), etc. Similar, but more complex, formulae were used for the earlier years of origin.

B7 Employers Liability (AVC)

B7.1 The number of claims as estimated at the end of the year of origin was not part of our data for years of origin 1975-80. The data included the number of claims as estimated at the end of each year 1981-87. The number of claims as at the end of the year of origin could then be estimated for these years using chain ladder techniques in reverse (cf B6.2).

B7.2 The calculations were as at B3 (with obvious modifications) averaging indexed payments per claim for payments in 1981-87 for each year of run-off (1980-87 for run-off year 0).

B8 Employers Liability (CI)

B8.1 As in B4 the ratios $r(Y,n)$ were calculated. Initially $r(Y,n)$ was only available for $1980<Y+n<1988$ and $(1980,0)$. Also, of course, $o(1987-n,n)$ and $c(1980-n,n)$ were available, where $o(Y,n)$ is as in B4.2 and $c(Y,n)$ is the (assumed) proportion of payments for year Y paid by the end of run-off year n; i.e. $c(Y,n)=(Y,0)+..r(Y,n)$.

B8.2 The $r(y,n)$ for $Y+n>1987$ were calculated as in B4.2. For $Y+n<1981$ they were calculated, working from right to left, using the formulae $r(Y,n)=c(Y,n).g(n)$ and $c(Y,n-1)=c(Y,n)-r(Y,n)$. $g(n)$ is the sum (over Y) of the given $r(Y,n)$ divided by the sum of the corresponding $c(Y,n)$. $r(y,0)$ is of course $c(Y,0)$.

4

B9 Motor (5 companies)

For five companies separate Comp and Non-comp data was available for the years 1975-80. For these companies the methods described in B5-B8 were used, except that in the IACL and AVC methods payments in the extreme tail were assumed to be subject to 2 years additional inflation and not 4. Proportions paid in years 11, 12 and later were aggregated after concluding the calculations. Mean terms at the start of year 11 were then taken to be 2 years for consistency with other companies.

B10 Motor (BCL)

B10.1 The data include payments in each year 1981-87 for each year of origin 1981-87, for Comp and Non-comp separately. For Private Motor the data are as described in B5. The Private Motor data for years of origin 1981-87 were obtained by adding the data for Comp and Non-comp.

B10.2 Chain ladder ratios $r(0),..,r(3)$ were calculated separately for Comp and Non-comp as described in B1.

B10.3 To extend the run-off pattern to the right, ratios were derived from Private Motor data relating to payments after year 2. To this end, payments in years 0-2 were estimated for years of origin 1975-77, using BCL methods on the Private Motor data. Using these estimates we constructed a triangle of cumulative payments, excluding payments in years 0-2, with the top left hand corner missing (ie the first 2 entries for 1975 and the first entry for 1976).

B10.4 The chain ladder factors derived from this table may be called $q(3)$ (not used), $q(4),...$. As $q(10)$ and $q(11)$ were not used, $q(u)$ was taken as 1 + the arithmetic average of:
      (1975) (outstandings + paid in 1986-87)/(paid in 1978-85)
      (1976) (outstandings + paid in 1987)/(paid in 1979-86)
      (1977) outstandings/(paid in 1980-87)

B10.5 The q(4),..,q(9),q(u) derived from the Private Motor data were used together with r(0),..,r(3) for Comp or Non-comp to derive the payment pattern. So, except for the five companies referred to in B9, the tail of the derived pattern has the same shape for Comp and Non-comp.

B11 Motor (IACL)

B11.1 The data were as in B10. Payments were adjusted to 1987 values as described in B2 and B6, using the earnings index.

B11.2 q(4), .., q(9) were derived much as described in B10.3 and B10.4, and formulae similar to those in B10.4 were used to define q(u). The differences were that the paid amounts were indexed to 1987 values and the outstanding amounts divided by $F=1.08^{2.5}$.

B11.3 The indexed run-off pattern defined by r(0), .., r(3), q(4), .., q(9), q(u) was converted to one appropriate to 8% inflation in the way described in B2.3. Again, except for five companies, this forces the tail to have the same shape for Comp and Non-comp.

B12 Motor (AVC)

B12.1 The data included also number of claims as estimated at the end of the year of origin separately for Comp and Non-comp. A(0), A(1), A(2), A(3), A(4) were estimated as described in B3, using the earnings index.

B12.2 The run-off patterns were completed using the ratios q(4),..,q(u) obtained for the IACL (B11) and the patterns quoted were those appropriate to 8% inflation. So, except for five companies, the shape of the derived tail is the same as for the IACL.

B13 Motor (CI)

B13.1 The data included the outstandings as at the end of 1987 for years of origin 1981-7, for Comp and Non-comp separately; and for years 1975-80, for Private Car.

B13.2 For Comp and Non-comp separately, r(Y,n) and o(Y,n) were calculated as described in B4 for Y+n<1988 and n<4 (1980<Y<1988). The Private Car data (including Comp and Non-comp for years of origin 1981-7) was analysed as described in B8 for EL so as to compute the f(n) appropriate to Private Car. The f(n) so computed were used in place of the f(n) computed from Comp or Non-comp data to calculate r(Y,n) and o(Y,n) for n>3.

B13.3 Then the run-off pattern consists of the averages (over 1980<Y<1988) of r(Y,0), .., r(Y,10), o(Y,10). Clearly the shape of the derived tail is the same for Comp and Non-comp.

B14 Mean term

Mean terms were calculated from the run-off patterns assuming, in each case, that on average payments in a year were at mid-year and that the payments after the last year shown separately were 2 years (4 years for EL) after the end of that year. The mean terms were calculated as at the beginning of each year of the run-off and are shown in Section C.

B15 Weighted mean terms

B15.1 For Fire these are weighted averages of the derived mean terms of claims outstanding at the start of years 1,2,...,7 of the run-off. The weights are the proportions outstanding at these durations according to the derived run-off pattern. Thus the weighted mean terms are unaffected by changes over time in the amount of claims payments. They are intended as a one parameter index for comparison of the overall length of the run-off of claims incurred between companies, and are not appropriate

for use within a company where it would be appropriate to weight by the estimated amounts outstanding.

B15.2 For EL these are weighted averages of mean terms as at the start of years 1,...,13. For motor as at the start of years 1,..11.

B16 <u>Alternative assumptions for future inflation and mean terms</u>

For the IACL and AVC methods appropriate changes were made to the formulae to allow for these. In particular F was altered. For the BCL and CI methods these assumptions had no effect on the run-off patterns shown, though obviously the assumption about the mean term of the tail affected all the mean terms quoted.

SECTION C
RUN-OFF PATTERNS & MEAN TERMS

3.	Fire	IACL	Run-off patterns
4.			Mean terms
5.		BCL	Run-off patterns
6.			Mean terms
7.		AV CLAIM	Run-off patterns
8.			Mean terms
9.		CO INC	Run-off patterns
10.			Mean terms
11.	EL	IACL	Run-off patterns
12.			Mean terms
13.		BCL	Run-off patterns
14.			Mean terms
15.		AV CLAIM	Run-off patterns
16.			Mean terms
17.		CO INC	Run-off patterns
18.			Mean terms
19.	COMP	IACL	Run-off patterns
20.			Mean terms
21.		BCL	Run-off patterns
22.			Mean terms
23.		AV CLAIM	Run-off patterns
24.			Mean terms
25.		CO INC	Run-off patterns
26.			Mean terms
27.	NON-COMP	IACL	Run-off patterns
28.			Mean terms
29.		BCL	Run-off patterns
30.			Mean terms
31.		AV CLAIM	Run-off patterns
32.			Mean terms
33.		CO INC	Run-off patterns
34.			Mean terms

In the tables above "size" is the total of the claims payments included in the analyses, excluding payments relating to years of origin 1975-80 for the motor risk groups.

SENSITIVITY ANALYSES

35.	Variation in Ult mean term	IACL	FIRE/EL
36.			COMP/NON-COMP
37.		BCL	FIRE/EL
38.			COMP/NON-COMP
39.		AV CLAIM	FIRE/EL
40.			COMP/NON-COMP
41.		CO INC	FIRE/EL
42.			COMP/NON-COMP
43.	Variation in assumed future inflation	IACL	FIRE/EL
44.			COMP/NON-COMP
45.		AV CLAIM	FIRE/EL
46.			COMP/NON-COMP

WEIGHTED MEAN TERMS

47. FIRE
48. EL
49. COMP
50. NON-COMP

989-003

Method : INFLATION ADJUSTED CHAIN LADDER

RUN-OFF PATTERN PER MILLE

NAME	SIZE	0	1	2	3	4	5	6	7+
Avon	23782	465	333	71	29	10	7	3	83
Britannic	2485	580	361	63	0	-5	0	0	0
Commercial Union	452908	495	362	87	30	12	-2	0	15
Co-operative	4066	578	337	55	19	-1	4	-1	11
Cornhill	36234	537	362	57	16	21	-4	1	11
Eagle Star	62206	527	341	65	29	15	7	2	14
Ecclesiastical	80600	273	519	103	28	8	1	-14	83
Economic	9663	525	373	58	34	-1	2	0	9
General Accident	315729	492	408	60	16	13	2	-3	13
Guardian Royal	514035	538	343	70	25	6	3	1	14
Ins Co of North America	39489	318	462	130	63	17	10	11	-10
Iron Trades Mutual	27643	590	370	30	4	3	3	-4	5
Legal & General	45272	454	408	84	22	9	3	-10	30
Minster	10953	412	425	124	25	3	0	0	10
Municipal General	24516	536	304	65	42	14	4	0	35
Municipal Mutual	276251	274	318	196	98	50	18	12	35
National Employers Mutual	56116	522	333	67	28	16	14	5	14
National Farmers Union Mutual	78373	694	300	8	0	0	-4	-3	4
Norwich Union	126619	470	417	73	25	8	2	-8	14
Provincial	4057	564	362	53	28	-16	0	-7	26
Prudential	109167	504	397	65	20	5	1	-1	9
Refuge	1596	750	231	13	3	0	0	4	-1
Royal	267651	512	397	75	15	2	-4	-2	5
Sun Alliance & London	1094558	520	340	77	30	12	7	3	11
Wesleyan & General	16198	670	270	34	16	6	-7	2	9
Total	4328147	495	358	82	31	13	4	1	16

Risk group : FIRE

Method : INFLATION ADJUSTED CHAIN LADDER

MEAN TERM

NAME	0	1	2	3	4	5	6	7+
Avon	1.85	2.03	3.55	4.20	4.27	3.67	2.92	2.00
Britannic	.97	.62	.33	1.51	.50	.00	.00	.00
Commercial Union	1.30	1.08	1.54	2.19	3.12	4.41	3.02	2.00
Co-operative	1.10	.92	1.56	2.48	4.71	3.30	3.33	2.00
Cornhill	1.18	.98	1.69	2.20	2.19	5.82	2.88	2.00
Eagle Star	1.28	1.15	1.85	2.16	2.44	2.73	2.72	2.00
Ecclesiastical	1.97	1.52	3.05	4.52	4.95	4.42	3.49	2.00
Economic	1.17	.92	1.44	1.71	4.70	3.40	3.00	2.00
General Accident	1.23	.93	1.67	2.43	2.71	4.06	3.61	2.00
Guardian Royal	1.23	1.07	1.69	2.39	3.37	3.37	2.85	2.00
Ins Co of North America	1.51	.98	.98	.67	.04	-1.70	-22.86	2.00
Iron Trades Mutual	.98	.68	1.34	2.89	3.17	4.03	14.56	2.00
Legal & General	1.39	1.13	1.98	3.26	4.12	4.59	4.20	2.00
Minster	1.35	.94	1.10	2.04	3.92	3.87	3.00	2.00
Municipal General	1.43	1.51	2.44	2.76	3.59	3.67	3.00	2.00
Municipal Mutual	2.16	1.79	1.79	1.98	2.24	2.57	2.36	2.00
National Employers Mutual	1.34	1.26	2.00	2.27	2.28	2.12	2.33	2.00
National Farmers Union Mutual	.82	.53	1.27	-2.45	-2.99	-4.04	7.95	2.00
Norwich Union	1.25	.91	1.43	2.10	3.55	5.92	6.31	2.00
Provincial	1.15	1.00	2.10	3.90	38.32	5.04	3.99	2.00
Prudential	1.18	.88	1.39	2.08	3.19	3.77	3.26	2.00
Refuge	.78	.62	1.13	1.38	1.40	.55	-.45	2.00
Royal	1.11	.75	.65	1.49	17.01	-18.12	4.18	2.00
Sun Alliance & London	1.28	1.12	1.63	2.02	2.39	2.49	2.49	2.00
Wesleyan & General	.96	.90	1.71	2.34	4.50	10.09	2.65	2.00
Total	1.33	1.14	1.70	2.20	2.75	3.15	2.84	2.00

RUN-OFF PATTERN PER MILLE

NAME	SIZE	0	1	2	3	4	5	6	7+
Avon	23762	484	330	68	28	8	6	2	73
Britannic	2485	594	354	57	0	-4	0	0	0
Commercial Union	452908	511	356	83	27	11	-1	0	14
Co-operative	4066	592	329	51	17	-1	3	-1	9
Cornhill	36234	551	355	54	15	19	-4	1	10
Eagle Star	62066	541	337	62	27	14	6	1	12
Ecclesiastical	8060	283	518	101	27	7	1	-11	75
Economic	9563	537	366	57	30	0	2	0	8
General Accident	315729	505	402	57	15	11	1	-2	11
Guardian Royal	514035	552	397	67	23	5	2	1	13
Ins Co of North America	39489	330	462	124	59	16	8	9	-8
Iron Trades Mutual	27643	601	360	29	3	2	3	-3	4
Legal & General	45272	467	405	79	20	9	3	-8	26
Minster	10953	423	422	119	24	3	3	0	9
Municipal General	24516	550	302	62	40	13	3	0	32
Municipal Mutual	276251	291	321	191	98	46	16	10	33
National Employers Mutual	56116	539	328	63	26	14	12	4	13
National Farmers Union Mutual	78373	702	292	8	0	0	-4	-2	4
Norwich Union	126619	463	412	69	21	7	1	-7	12
Provincial	42057	575	344	52	26	-14	0	-6	23
Prudential	109167	518	390	61	18	5	1	-1	8
Refuge	1596	761	222	12	3	0	0	3	-1
Royal	267651	525	389	71	14	2	-4	-1	4
Sun Alliance & London	1094558	535	334	74	28	11	6	2	10
Wesleyan & General	16198	681	264	33	15	5	-6	1	8
Total	4328147	510	353	78	29	12	4	1	14

Risk group : FIRE

Method : BASIC CHAIN LADDER

MEAN TERM

NAME	0	1	2	3	4	5	6	7+
Avon	1.75	1.92	3.43	4.14	4.28	3.67	2.92	2.00
Britannic	.95	.61	.34	1.50	.50	.00	.00	.00
Commercial Union	1.25	1.04	1.49	2.14	3.09	4.34	3.01	2.00
Co-operative	1.07	.89	1.53	2.43	4.51	3.31	3.30	2.00
Cornhill	1.15	.95	1.64	2.16	2.14	5.68	2.89	2.00
Eagle Star	1.24	1.11	1.79	2.12	2.44	2.77	2.74	2.00
Ecclesiastical	1.90	1.45	2.93	4.44	4.92	4.38	3.44	2.00
Economic	1.15	.90	1.42	1.72	4.44	3.44	3.00	2.00
General Accident	1.19	.90	1.62	2.39	2.68	4.00	3.56	2.00
Guardian Royal	1.19	1.03	1.64	2.36	3.42	3.41	2.86	2.00
Ins Co of North America	1.48	.96	.97	.67	.07	-1.68	-25.60	2.00
Iron Trades Mutual	.97	.67	1.28	2.77	3.05	3.84	11.60	2.00
Legal & General	1.35	1.09	1.94	3.20	4.05	4.48	4.07	2.00
Minster	1.32	.93	1.08	2.00	3.95	3.88	3.00	2.00
Municipal General	1.38	1.45	2.38	2.71	3.57	3.69	3.00	2.00
Municipal Mutual	2.09	1.74	1.75	1.96	2.25	2.61	2.40	2.00
National Employers Mutual	1.29	1.20	1.94	2.25	2.31	2.18	2.38	2.00
National Farmers Union Mutual	.81	.53	1.19	-2.63	-3.11	-4.24	7.30	2.00
Norwich Union	1.21	.88	1.39	2.10	3.49	5.65	5.88	2.00
Provincial	1.13	.98	2.03	3.72	28.13	4.87	3.65	2.00
Prudential	1.15	.86	1.37	2.08	3.19	3.78	3.23	2.00
Refuge	.77	.62	1.11	1.37	1.54	.72	-.28	2.00
Royal	1.09	.74	.65	1.44	12.40	-27.42	4.09	2.00
Sun Alliance & London	1.24	1.09	1.59	2.00	2.41	2.54	2.54	2.00
Wesleyan & General	.94	.88	1.67	2.29	4.39	8.98	2.68	2.00
Total	1.29	1.10	1.65	2.17	2.75	3.17	2.85	2.00

Risk group : FIRE

Method : AVERAGE CLAIM

RUN-OFF PATTERN PER MILLE

NAME	SIZE	0	1	2	3	4	5	6	7+
Avon	23782	442	345	78	30	11	8	3	83
Britannic	2465	600	346	58	0	-4	0	0	0
Commercial Union	462908	480	373	91	31	12	-4	0	17
Co-operative	4066	599	326	55	19	-2	3	-1	12
Cornhill	36234	521	375	58	16	22	-4	1	12
Eagle Star	622086	528	346	63	27	14	7	2	13
Ecclesiastical	80600	289	511	101	30	7	1	-10	72
Economic	9563	527	379	62	27	-3	2	0	6
General Accident	315729	481	415	64	17	12	1	-3	13
Guardian Royal	514085	537	345	69	25	6	3	1	14
Ins Co of North America	39489	389	430	111	47	14	10	9	-9
Iron Trades Mutual	27643	579	378	32	3	2	4	-3	5
Legal & General	45272	469	405	81	20	8	2	-9	24
Minster	10953	392	437	133	27	2	0	0	9
Municipal General	24516	524	320	71	38	9	4	0	34
Municipal Mutual	276251	270	317	200	97	51	18	13	35
National Employers Mutual	56116	515	338	66	29	18	16	5	14
National Farmers Union Mutual	78373	680	314	8	1	0	-4	-3	4
Norwich Union	126619	468	416	76	26	8	1	-8	13
Provincial	42057	546	365	54	28	-13	-1	-6	26
Prudential	109167	516	392	62	18	5	1	-1	7
Refuge	15796	765	219	12	3	0	0	3	-1
Royal	267651	507	400	78	15	2	-5	-2	5
Sun Alliance & London	1094558	516	347	77	29	12	7	3	10
Wesleyan & General	16198	686	262	32	13	6	-7	1	8
Total	4320147	490	364	83	31	13	4	1	15

Risk group : FIRE

Method : AVERAGE CLAIM

MEAN TERM

NAME	0	1	2	3	4	5	6	7+
Avon	1.90	2.01	3.45	4.15	4.21	3.64	2.98	2.00
Britannic	.95	.61	.34	1.53	.50	.00	.00	.00
Commercial Union	1.32	1.08	1.54	2.23	3.33	4.95	3.02	2.00
Co-operative	1.10	.95	1.67	2.74	5.23	3.43	3.23	2.00
Cornhill	1.21	.98	1.72	2.22	2.14	5.45	2.90	2.00
Eagle Star	1.26	1.12	1.88	2.18	2.44	2.72	2.72	2.00
Ecclesiastical	1.89	1.45	2.87	4.28	4.88	4.35	3.41	2.00
Economic	1.13	.84	1.21	1.57	6.42	3.23	3.00	2.00
General Accident	1.24	.93	1.64	2.42	2.80	4.24	3.59	2.00
Guardian Royal	1.22	1.06	1.69	2.38	3.30	3.32	2.84	2.00
Ins Co of North America	1.38	.93	.95	.67	.00	-1.67	-96.97	2.00
Iron Trades Mutual	1.00	.69	1.42	3.12	2.98	3.03	6.43	2.00
Legal & General	1.32	1.05	1.81	3.13	4.12	4.79	4.46	2.00
Minster	1.37	.93	1.04	1.86	4.01	3.85	3.00	2.00
Municipal General	1.42	1.44	2.36	2.91	3.82	3.60	3.00	2.00
Municipal Mutual	2.18	1.80	1.79	2.00	2.23	2.58	2.34	2.00
National Employers Mutual	1.36	1.27	2.02	2.26	2.21	2.06	2.31	2.00
National Farmers Union Mutual	.83	.53	1.25	-2.99	-3.21	-3.98	8.75	2.00
Norwich Union	1.25	.91	1.36	1.96	3.56	6.16	6.69	2.00
Provincial	1.19	1.02	2.17	3.74	15.97	4.92	3.73	2.00
Prudential	1.15	.84	1.30	1.98	3.13	3.70	3.26	2.00
Refuge	.76	.61	1.10	1.45	1.52	.67	-.33	2.00
Royal	1.12	.75	.84	1.59	21.69	-16.38	3.98	2.00
Sun Alliance & London	1.27	1.09	1.59	2.00	2.38	2.47	2.47	2.00
Wesleyan & General	.92	.85	1.62	2.34	4.66	15.82	2.62	2.00
Total	1.33	1.13	1.68	2.20	2.76	3.19	2.84	2.00

RUN-OFF PATTERN PER MILLE

NAME	SIZE	0	1	2	3	4	5	6	7+
Avon	23782	458	350	73	27	10	8	2	73
Britannic	2465	575	339	58	0	29	0	0	0
Commercial Union	452908	474	362	91	36	18	-5	0	26
Co-operative	4066	544	341	68	27	-12	13	-5	24
Cornhill	36234	499	365	61	21	40	-12	2	26
Eagle Star	622086	520	345	67	29	16	8	2	15
Ecclesiastical	8000	287	496	104	31	8	2	-55	128
Economic	9563	508	380	59	28	-6	32	0	0
General Accident	315729	457	395	71	29	26	4	-7	27
Guardian Royal	514055	537	345	69	25	6	4	1	13
Ins Co of North America	39489	320	475	123	56	16	6	3	0
Iron Trades Mutual	27643	532	385	57	8	7	16	-4	1
Legal & General	45272	433	404	97	28	12	7	66	-47
Minster	10953	404	387	107	38	13	6	0	44
Municipal General	24516	542	318	67	34	8	5	14	14
Municipal Mutual	276251	269	317	194	100	53	21	16	30
National Employers Mutual	56116	512	339	69	29	17	15	4	15
National Farmers Union Mutual	78373	647	337	14	-2	0	3	1	0
Norwich Union	126619	439	406	83	43	16	9	29	-23
Provincial	4205?	525	372	51	29	-31	21	42	-9
Prudential	109167	487	395	67	22	11	8	-23	33
Refuge	15796	741	233	15	3	1	0	4	2
Royal	267651	490	405	83	18	10	-7	2	-1
Sun Alliance & London	1094558	510	344	79	31	13	8	3	11
Wesleyan & General	16198	668	270	37	15	7	-3	-3	-3
Total	4328147	481	360	85	34	16	6	2	17

Risk group : FIRE

Method : COMPANY INCURRED

MEAN TERM

NAME	0	1	2	3	4	5	6	7+
Avon	1.79	1.87	3.38	4.14	4.18	3.62	2.93	2.00
Britannic	1.07	.84	1.17	1.50	.50	—	—	—
Commercial Union	1.41	1.23	1.85	2.51	3.36	4.93	3.02	2.00
Co-operative	1.25	1.15	2.06	3.27	5.85	2.92	3.59	2.00
Cornhill	1.38	1.25	2.25	2.64	2.45	6.43	2.80	2.00
Eagle Star	1.30	1.17	1.87	2.20	2.41	2.70	2.75	2.00
Ecclesiastical	2.09	1.73	3.54	5.34	6.12	5.76	4.92	2.00
Economic	1.22	.95	1.49	1.58	1.74	.50	—	—
General Accident	1.43	1.22	2.12	2.58	2.77	4.21	3.89	2.00
Guardian Royal	1.22	1.06	1.67	2.30	3.17	3.10	2.81	2.00
Ins Co of North America	1.51	.98	1.09	.98	1.05	.96	.79	2.00
Iron Trades Mutual	1.11	.80	1.18	1.63	1.08	.40	-.13	2.00
Legal & General	1.27	.85	.72	.04	-1.30	-3.10	-5.46	2.00
Minster	1.68	1.47	2.28	3.16	3.75	3.56	3.00	2.00
Municipal General	1.31	1.26	1.97	2.31	2.87	2.43	1.75	2.00
Municipal Mutual	2.17	1.79	1.77	1.90	2.07	2.30	2.12	2.00
National Employers Mutual	1.36	1.26	1.98	2.26	2.28	2.17	2.50	2.00
National Farmers Union Mutual	.88	.58	1.17	4.58	1.59	.55	-.27	2.00
Norwich Union	1.28	.89	.92	.39	-.76	-3.12	-9.38	2.00
Provincial	1.22	1.01	1.85	2.18	3.38	.71	-.17	2.00
Prudential	1.32	1.10	2.11	3.25	4.35	5.61	8.83	2.00
Refuge	.82	.73	1.85	2.82	2.94	2.26	1.33	2.00
Royal	1.13	.74	.65	.25	-2.00	.81	-4.50	2.00
Sun Alliance & London	1.30	1.14	1.64	1.98	2.28	2.33	2.42	2.00
Wesleyan & General	.92	.76	.90	.46	-.59	-3.45	1.75	2.00
Total	1.38	1.20	1.77	2.20	2.62	2.96	2.79	2.00

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
Avon	2729	23	145	187	199	135	198	86	26	0	1	0	0	0	0
Commercial Union	96849	60	197	221	188	140	89	47	24	16	9	6	3	1	1
Co-operative	12939	37	159	184	177	164	115	75	51	20	6	7	2	0	2
Cornhill	14576	27	179	241	215	127	88	45	29	40	3	2	0	1	2
Eagle Star	313672	25	171	208	180	129	86	53	38	20	18	10	10	20	33
General Accident	88894	27	166	231	188	146	82	52	29	19	12	20	3	5	21
Guardian Royal	134024	42	205	210	163	138	89	54	35	24	11	9	4	0	16
Iron Trades Mutual	21669	22	159	212	183	141	104	66	40	45	18	7	0	2	2
Iron Trades Employers	217328	44	224	214	172	124	74	52	35	24	15	9	2	2	9
Legal & General	18212	18	121	202	185	158	85	81	42	17	9	4	16	1	60
National Employers Mutual	44051	24	159	206	184	131	98	66	39	24	11	8	3	12	34
Norwich Union	28209	20	141	219	212	158	103	42	33	25	7	19	1	3	16
Orion	5316	12	97	184	163	115	117	118	152	34	-1	0	0	0	9
Pearl	5116	19	95	222	192	168	107	37	42	40	9	9	0	3	57
Provincial	12075	22	173	265	192	125	94	61	20	19	15	3	3	4	6
Prudential	21557	52	153	220	204	139	82	59	42	34	6	3	3	3	-1
Royal	44870	33	178	192	161	114	85	58	31	20	19	7	4	3	93
Sun Alliance & London	83032	21	146	200	190	150	104	66	38	28	10	5	6	5	32
Wesleyan & General	118	32	168	140	87	351	0	223	0	0	0	0	0	0	0
Total	1166036	33	181	213	181	135	87	55	35	23	14	9	5	7	24

Risk group : EMPLOYERS LIABILITY

Method : INFLATION ADJUSTED CHAIN LADDER

MEAN TERM

Name	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
Avon	3.85	2.93	2.36	1.89	1.52	.96	.76	.60	1.50	.50	.00	.00	.00	.00
Commercial Union	3.48	2.67	2.25	1.99	1.82	1.77	1.82	1.86	1.77	1.79	1.79	2.19	3.09	4.00
Co-operative	3.94	3.07	2.58	2.20	1.88	1.69	1.54	1.43	1.71	2.17	2.00	3.14	5.00	4.00
Cornhill	3.65	2.74	2.24	2.00	1.96	1.83	1.79	1.53	1.14	3.11	3.68	4.81	3.81	4.00
Eagle Star	4.47	3.57	3.23	3.17	3.33	3.60	3.92	4.14	4.38	4.24	4.16	3.75	3.34	4.00
General Accident	4.09	3.19	2.75	2.65	2.69	3.01	3.30	3.64	3.77	3.77	3.55	4.71	4.17	4.00
Guardian Royal	3.88	3.03	2.71	2.56	2.45	2.55	2.75	2.98	3.32	4.00	4.25	4.95	4.91	4.00
Iron Trades Mutual	4.04	3.12	2.63	2.37	2.18	2.01	1.88	1.67	1.30	1.53	2.17	3.70	2.68	4.00
Iron Trades Employers	3.71	2.85	2.57	2.43	2.38	2.43	2.40	2.41	2.50	2.82	3.38	4.24	4.05	4.00
Legal & General	4.86	3.94	3.43	3.32	3.42	3.88	4.13	5.10	5.91	5.91	5.49	4.77	4.90	4.00
National Employers Mutual	4.42	3.52	3.11	2.99	3.06	3.20	3.54	4.05	4.55	4.98	4.86	4.55	3.85	4.00
Norwich Union	4.11	3.19	2.64	2.40	2.39	2.58	3.04	3.07	3.26	3.77	3.38	5.01	4.23	4.00
Orion	4.69	3.74	3.09	2.76	2.44	1.96	1.50	1.11	2.28	8.91	7.00	6.00	5.00	4.00
Pearl	4.81	3.89	3.25	3.17	3.25	3.78	4.57	4.51	4.95	6.21	5.95	5.76	4.76	4.00
Provincial	3.74	2.82	2.31	2.20	2.13	2.04	2.14	2.59	2.42	2.64	3.75	3.44	3.19	4.00
Prudential	3.73	2.91	2.37	2.09	1.96	1.85	1.59	1.29	.99	1.14	.57	-.38	-2.96	4.00
Royal	5.02	4.18	4.01	4.14	4.49	4.90	5.48	6.11	6.28	6.21	6.23	5.65	4.84	4.00
Sun Alliance & London	4.42	3.50	3.03	2.82	2.82	2.99	3.35	3.85	4.33	5.21	5.23	4.80	4.44	4.00
Wesleyan & General	3.95	3.06	2.60	2.04	1.28	1.50	.50	.00	.00	.00	.00	.00	.00	.00
Total	4.12	3.25	2.88	2.76	2.80	2.99	3.26	3.57	3.91	4.23	4.38	4.35	3.97	4.00

Risk group : EMPLOYERS LIABILITY

Method : BASIC CHAIN LADDER

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
Axon	2729	22	145	192	204	150	169	87	30	0	2	0	0	0	0
Commercial Union	96949	52	189	217	190	142	95	50	26	18	10	6	3	1	2
Co-operative	12999	35	154	179	172	167	112	79	59	23	7	8	3	0	2
Cornhill	14576	26	172	237	212	129	90	48	34	43	4	3	0	1	3
Eagle Star	313672	23	164	200	176	128	89	56	40	22	19	11	11	23	37
General Accident	88894	26	161	227	185	145	83	54	30	21	13	24	3	6	23
Guardian Royal	134024	41	197	202	160	140	91	59	38	26	11	11	4	0	18
Iron Trades Mutual	21669	21	151	204	180	144	109	68	42	49	19	8	0	3	2
Iron Trades Employers	217328	43	214	207	169	126	77	57	38	28	18	10	3	3	10
Legal & General	18212	18	122	201	178	154	84	82	44	17	9	5	19	2	66
National Employers Mutual	44051	23	152	199	180	131	100	70	41	26	14	9	4	14	38
Norwich Union	28209	19	137	214	206	156	108	45	35	27	8	22	1	4	19
Orion	5316	12	95	184	164	117	132	119	136	33	-1	0	0	0	10
Pearl	5116	20	93	222	186	168	102	40	43	43	10	10	0	4	60
Provincial	12075	21	164	255	191	130	98	65	21	20	18	3	3	5	7
Prudential	21557	49	150	223	201	136	85	62	46	33	6	4	4	4	-2
Royal	44870	32	172	184	156	111	86	61	32	23	22	8	4	4	106
Sun Alliance & London	83632	19	139	192	185	150	107	70	41	32	11	6	6	6	36
Wesleyan & General	118	33	156	145	88	319	0	259	0	0	0	0	0	0	0
Total	116036	31	173	206	177	135	90	59	38	25	15	10	6	8	27

MEAN TERM

Name	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
Avon	3.83	2.91	2.32	1.87	1.51	1.03	.79	.61	1.50	.50	.00	.00	.00	.00
Commercial Union	3.58	2.75	2.32	2.04	1.87	1.79	1.65	1.89	1.78	1.79	1.80	2.11	3.01	4.00
Co-operative	4.03	3.16	2.67	2.28	1.95	1.78	1.58	1.42	1.71	2.11	1.93	3.11	5.00	4.00
Cornhill	3.73	2.82	2.32	2.08	2.02	1.89	1.81	1.54	1.20	3.16	3.61	4.77	3.77	4.00
Eagle Star	4.64	3.73	3.39	3.33	3.47	3.70	4.00	4.21	4.41	4.23	4.11	3.68	3.27	4.00
General Accident	4.20	3.30	2.86	2.77	2.81	3.12	3.35	3.65	3.72	3.69	3.44	4.59	4.08	4.00
Guardian Royal	3.99	3.14	2.83	2.67	2.53	2.63	2.79	3.01	3.34	3.98	4.15	4.89	4.90	4.00
Iron Trades Mutual	4.13	3.21	2.71	2.43	2.21	2.04	1.91	1.69	1.32	1.55	2.09	3.60	2.60	4.00
Iron Trades Employers	3.84	2.98	2.70	2.54	2.48	2.50	2.44	2.44	2.49	2.76	3.30	4.15	3.98	4.00
Legal & General	4.97	4.05	3.56	3.49	3.60	4.06	4.29	5.23	6.01	5.95	5.47	4.73	4.90	4.00
National Employers Mutual	4.59	3.68	3.27	3.14	3.20	3.32	3.62	4.12	4.53	4.87	4.78	4.46	3.78	4.00
Norwich Union	4.23	3.31	2.76	2.53	2.51	2.68	3.15	3.18	3.34	3.74	3.32	4.97	4.20	4.00
Orion	4.67	3.72	3.06	2.72	2.39	1.91	1.53	1.22	2.56	8.88	7.00	6.00	5.00	4.00
Pearl	4.88	3.97	3.33	3.28	3.36	3.90	4.56	4.50	4.87	6.13	5.86	5.72	4.72	4.00
Provincial	3.85	2.92	2.41	2.28	2.19	2.11	2.22	2.69	2.50	2.65	3.74	3.42	3.15	4.00
Prudential	3.78	2.94	2.40	2.13	2.00	1.85	1.58	1.29	1.02	1.10	.50	-.51	-3.17	4.00
Royal	5.27	4.42	4.27	4.40	4.74	5.11	5.63	6.21	6.29	6.21	6.24	5.64	4.84	4.00
Sun Alliance & London	4.56	3.64	3.16	2.96	2.93	3.08	3.42	3.91	4.33	5.22	5.20	4.75	4.41	4.00
Wesleyan & General	4.04	3.16	2.67	2.15	1.40	1.50	.50	.00	.00	.00	.00	.00	.00	.00
Total	4.26	3.38	3.01	2.89	2.92	3.09	3.34	3.63	3.93	4.21	4.33	4.28	3.91	4.00

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
Avon	2729	23	151	190	199	117	222	76	20	0	2	0	0	0	0
Commercial Union	96849	50	169	214	197	154	101	52	26	17	10	6	4	1	-1
Co-operative	12939	36	144	181	174	163	131	83	49	23	6	8	3	0	-1
Cornhill	14576	26	173	251	224	128	83	43	29	34	3	2	0	1	2
Eagle Star	313672	23	167	208	180	128	87	53	38	20	17	10	10	20	38
General Accident	88894	28	172	246	195	150	80	46	24	15	9	15	2	4	12
Guardian Royal	134024	43	210	216	171	139	88	51	32	21	9	7	3	0	10
Iron Trades Mutual	21669	21	155	210	178	142	108	69	43	46	19	7	0	2	1
Iron Trades Employers	217328	47	218	213	172	127	75	53	36	25	16	9	2	3	6
Legal & General	18212	19	131	212	183	157	83	79	42	16	9	4	15	1	49
National Employers Mutual	44051	21	145	192	179	136	109	75	43	24	11	8	4	14	38
Norwich Union	28209	21	151	212	210	159	104	43	34	26	7	19	1	3	11
Orion	5316	12	87	162	135	89	72	79	307	50	0	0	0	0	7
Pearl	5116	20	104	227	186	171	104	33	39	33	9	9	0	2	62
Provincial	12075	20	161	253	199	131	101	62	20	22	14	3	3	5	7
Prudential	21557	55	162	222	199	136	79	58	42	35	5	3	3	3	-2
Royal	44870	35	185	191	162	112	85	57	29	20	20	7	4	3	89
Sun Alliance & London	83832	24	167	221	195	143	97	55	30	21	8	4	5	4	26
Wesleyan & General	118	26	155	165	97	432	0	125	0	0	0	0	0	0	0
Total	1166036	32	179	214	182	136	88	55	35	22	13	9	5	7	23

MEAN TERM

Name	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
Avon	3.82	2.90	2.33	1.88	1.51	.88	.75	.64	1.50	.50	.00	.00	.00	.00
Commercial Union	3.63	2.80	2.29	1.97	1.75	1.64	1.63	1.55	1.29	.98	.46	-.60	-14.52	4.00
Co-operative	4.02	3.15	2.61	2.21	1.84	1.56	1.37	1.19	1.05	.83	.04	-2.80	5.00	4.00
Cornhill	3.60	2.68	2.15	1.91	1.88	1.78	1.72	1.46	1.15	3.14	3.76	4.73	3.73	4.00
Eagle Star	4.54	3.64	3.29	3.25	3.43	3.71	4.07	4.32	4.59	4.45	4.34	3.89	3.45	4.00
General Accident	3.83	2.92	2.45	2.31	2.30	2.59	2.90	3.23	3.37	3.38	3.14	4.32	3.85	4.00
Guardian Royal	3.70	2.84	2.50	2.31	2.17	2.23	2.38	2.56	2.89	3.64	4.01	4.72	4.88	4.00
Iron Trades Mutual	4.08	3.16	2.66	2.39	2.16	1.96	1.81	1.57	1.19	1.29	1.80	3.30	2.29	4.00
Iron Trades Employers	3.70	2.85	2.55	2.39	2.31	2.33	2.24	2.20	2.19	2.38	2.90	3.79	3.69	4.00
Legal & General	4.66	3.74	3.23	3.14	3.21	3.63	3.82	4.75	5.63	5.69	5.36	4.67	4.89	4.00
National Employers Mutual	4.62	3.71	3.27	3.10	3.10	3.19	3.54	4.14	4.70	5.06	4.87	4.51	3.79	4.00
Norwich Union	4.04	3.12	2.59	2.31	2.25	2.38	2.74	2.69	2.01	3.24	2.83	4.70	3.98	4.00
Orion	5.17	4.29	3.58	3.26	2.88	2.29	1.58	.81	1.52	8.33	7.00	6.00	5.00	4.00
Pearl	4.78	3.87	3.27	3.24	3.34	4.01	4.94	4.88	5.36	6.29	6.03	5.84	4.84	4.00
Provincial	3.84	2.91	2.38	2.22	2.15	2.07	2.23	2.69	2.52	2.90	3.89	3.51	3.24	4.00
Prudential	3.68	2.87	2.35	2.09	1.96	1.83	1.55	1.23	.88	.95	.26	-.92	-5.81	4.00
Royal	4.93	4.09	3.94	4.06	4.42	4.82	5.42	6.06	6.21	6.14	6.23	5.64	4.84	4.00
Sun Alliance & London	4.10	3.19	2.75	2.60	2.63	2.84	3.32	3.91	4.39	5.15	5.14	4.75	4.40	4.00
Wesleyan & General	3.75	2.84	2.28	1.73	.95	1.50	.50	.00	.00	.00	.00	.00	.00	.00
Total	4.11	3.23	2.85	2.73	2.76	2.95	3.23	3.54	3.89	4.21	4.35	4.30	3.92	4.00

Risk group : EMPLOYERS LIABILITY

Method : COMPANY INCURRED

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
Avon	2729	24	144	192	169	115	151	98	42	0	66	0	0	0	0
Commercial Union	96849	51	173	202	185	146	104	56	31	20	12	10	4	2	5
Co-operative	12939	33	140	170	172	159	122	79	48	24	9	25	13	4	4
Cornhill	14576	23	150	205	191	117	88	49	32	57	8	30	0	7	42
Eagle Star	313672	22	155	194	175	131	93	60	45	24	20	11	10	18	42
General Accident	88894	26	160	220	182	151	88	57	32	21	14	21	5	6	18
Guardian Royal	134024	44	207	207	160	131	91	56	37	26	13	8	5	1	15
Iron Trades Mutual	21669	19	146	192	163	132	111	84	60	56	25	7	0	2	5
Iron Trades Employers	217328	42	201	194	159	123	79	60	42	32	20	19	7	7	17
Legal & General	18212	17	112	191	179	163	92	94	47	19	10	4	12	1	60
National Employers Mutual	44051	22	149	203	181	138	102	68	44	24	11	8	3	18	28
Norwich Union	28209	19	129	196	197	150	107	51	48	40	11	25	1	3	26
Orion	5316	14	107	190	174	134	98	124	129	23	-1	0	3	3	3
Pearl	5116	19	92	205	186	160	113	46	54	42	9	8	0	6	60
Provincial	12075	18	146	225	179	127	109	74	28	31	29	6	4	5	18
Prudential	21557	54	150	202	190	140	82	66	46	45	6	8	6	4	1
Royal	44870	31	173	189	161	118	91	60	32	20	21	7	3	3	92
Sun Alliance & London	83832	19	132	183	177	141	104	70	43	33	17	9	9	8	55
Wesleyan & General	118	67	278	218	85	264	0	89	0	0	0	0	0	0	0
Total	1166036	30	166	198	173	135	93	62	42	27	17	12	6	9	32

Risk group : EMPLOYERS LIABILITY

Method : COMPANY INCURRED

MEAN TERM

Name	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
Axon	4.22	3.31	2.80	2.49	2.20	1.75	1.67	1.73	1.50	.50	—	—	—	—
Commercial Union	3.79	2.97	2.52	2.23	2.05	1.99	2.11	2.20	2.23	2.30	2.36	3.12	3.85	4.00
Co-operative	4.32	3.45	2.95	2.58	2.31	2.19	2.19	2.24	2.31	2.12	1.44	1.63	2.75	4.00
Cornhill	4.67	3.77	3.36	3.31	3.56	3.70	3.95	3.90	3.65	4.71	4.14	5.36	4.36	4.00
Eagle Star	4.73	3.82	3.45	3.36	3.46	3.67	3.96	4.18	4.51	4.47	4.44	4.07	3.66	4.00
General Accident	4.18	3.28	2.82	2.68	2.64	2.88	3.08	3.34	3.43	3.41	3.21	4.15	3.85	4.00
Guardian Royal	3.88	3.04	2.74	2.60	2.47	2.50	2.64	2.79	3.06	3.71	4.16	4.54	4.78	4.00
Iron Trades Mutual	4.36	3.43	2.94	2.67	2.41	2.13	1.89	1.66	1.40	1.73	3.02	5.08	3.88	4.00
Iron Trades Employers	4.16	3.32	3.06	2.95	2.91	2.96	2.91	2.92	2.95	3.07	3.11	3.80	3.71	4.00
Legal & General	4.94	4.01	3.47	3.30	3.30	3.65	3.82	4.88	5.84	6.03	5.76	5.07	4.94	4.00
National Employers Mutual	4.48	3.57	3.12	2.96	2.96	3.06	3.33	3.73	4.26	4.59	4.38	3.98	3.23	4.00
Norwich Union	4.52	3.59	3.06	2.82	2.82	2.94	3.21	3.12	3.31	4.02	3.70	5.37	4.59	4.00
Orion	4.48	3.54	2.91	2.57	2.26	1.88	1.36	1.02	2.12	5.02	3.67	2.67	2.75	4.00
Pearl	4.98	4.07	3.44	3.31	3.37	3.73	4.34	4.33	4.98	6.24	5.93	5.63	4.63	4.00
Provincial	4.30	3.37	2.87	2.74	2.68	2.59	2.76	3.15	2.94	3.18	4.58	4.41	4.10	4.00
Prudential	3.94	3.14	2.64	2.37	2.24	2.16	1.90	1.69	1.47	2.15	1.65	1.47	1.63	4.00
Royal	5.04	4.19	3.99	4.07	4.36	4.75	5.37	6.00	6.22	6.15	6.28	5.69	4.87	4.00
Sun Alliance & London	4.96	4.04	3.59	3.44	3.50	3.71	4.06	4.48	4.77	5.20	5.19	4.79	4.42	4.00
Wesleyan & General	3.06	2.24	1.98	1.71	1.01	1.50	.50	—	—	—	—	—	—	—
Total	4.43	3.55	3.18	3.06	3.08	3.25	3.49	3.76	4.09	4.35	4.44	4.41	4.02	4.00

Risk group : MOTOR - COMPREHENSIVE   Method : INFLATION ADJUSTED CHAIN LADDER

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	31691	648	230	35	32	22	19	6	2	2	3	0	0
Britannic	11180	630	230	35	32	33	10	10	1	1	4	11	3
Commercial Union	264077	655	226	36	30	29	12	7	3	1	1	0	0
Co-operative	239737	616	221	39	36	28	19	15	8	6	2	2	8
Cornhill	206572	620	236	39	37	25	18	9	5	5	3	1	3
Eagle Star *	326819	632	232	41	33	24	13	9	8	5	3	0	1
General Accident	594874	632	237	36	32	19	14	10	7	5	1	2	4
Guardian Royal	515861	639	239	43	35	19	12	6	3	2	1	0	0
Iron Trades Mutual *	183011	634	234	37	33	24	21	6	4	4	1	0	0
Legal & General	73122	602	255	37	32	24	20	12	9	3	1	2	2
London & Edinburgh	76420	591	255	42	47	18	20	16	8	2	0	1	0
National Employers Mutual	83565	621	227	37	38	25	16	11	13	11	1	1	0
National Farmers Union Mutual	118677	610	223	36	42	32	17	16	9	8	6	0	0
National Insurance & Guarantee	138462	614	254	41	32	28	15	7	6	1	0	0	1
Norman *	20622	604	237	41	49	25	22	6	5	11	0	0	0
Norwich Union *	306017	585	201	39	36	27	13	9	7	2	0	0	0
Pearl	42718	583	241	59	51	28	27	7	3	0	1	0	0
Provincial	158504	612	239	42	38	24	16	13	6	6	1	3	0
Prudential	250410	624	238	38	30	27	15	10	6	2	4	1	5
Royal *	361770	628	228	42	35	27	16	12	4	4	1	0	1
Sun Alliance & London	550728	627	246	41	34	21	15	9	4	2	1	1	1
Wesleyan & General	6389	588	213	33	36	61	49	8	13	0	0	0	0
Total	4561226	625	239	39	34	24	15	10	6	4	1	1	2

* For these companies separate Comp data were available.

Risk group : MOTOR - COMPREHENSIVE

Method : INFLATION ADJUSTED CHAIN LADDER

MEAN TERM

Name	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	1.17	1.41	2.15	1.84	1.62	1.36	1.64	1.60	1.08	.50	.00	.00
Britannic	1.33	1.75	2.80	2.56	2.48	3.13	3.00	3.31	2.51	1.64	.97	2.00
Commercial Union	1.15	1.37	2.03	1.69	1.35	1.36	1.24	1.23	1.61	1.49	1.65	2.00
Co-operative	1.45	1.96	2.94	2.70	2.61	2.60	2.61	2.79	2.88	3.15	2.58	2.00
Cornhill	1.31	1.64	2.51	2.26	2.21	2.21	2.39	2.37	2.12	2.19	2.30	2.00
Eagle Star *	1.25	1.55	2.35	2.13	2.00	1.94	1.70	1.35	1.11	1.09	2.45	2.00
General Accident	1.29	1.64	2.71	2.54	2.58	2.49	2.43	2.48	2.49	2.66	2.13	2.00
Guardian Royal	1.15	1.31	1.89	1.66	1.59	1.42	1.36	1.25	.92	.89	2.75	2.00
Iron Trades Mutual *	1.22	1.46	2.19	1.86	1.61	1.34	1.52	1.29	.83	1.12	.98	2.00
Legal & General	1.34	1.62	2.61	2.34	2.13	1.90	1.84	1.73	2.07	2.07	1.53	2.00
London & Edinburgh	1.33	1.54	2.25	1.91	1.95	1.50	1.21	1.19	1.66	2.05	1.29	2.00
National Employers Mutual	1.35	1.75	2.61	2.28	2.16	1.98	1.61	1.08	.69	1.01	.69	2.00
National Farmers Union Mutual	1.42	1.85	2.66	2.25	2.07	1.97	1.59	1.35	.92	.51	-.25	2.00
National Insurance & Guarantee	1.23	1.38	2.08	1.80	1.50	1.43	1.37	1.18	1.85	3.30	3.00	2.00
Norman *	1.33	1.60	2.26	1.88	1.86	1.63	1.73	1.21	.50	.00	.00	.00
Norwich Union *	1.26	1.34	2.09	1.76	1.54	1.44	1.15	.79	.87	3.38	1.96	2.00
Pearl	1.33	1.50	1.86	1.55	1.37	.99	1.11	1.18	1.83	1.16	.90	2.00
Provincial	1.32	1.62	2.42	2.17	2.10	1.93	1.72	1.70	1.39	1.53	.82	2.00
Prudential	1.31	1.66	2.65	2.47	2.31	2.44	2.52	2.69	2.72	2.29	2.55	2.00
Royal *	1.27	1.56	2.25	1.99	1.80	1.72	1.57	1.81	1.69	2.33	2.43	2.00
Sun Alliance & London	1.21	1.40	2.14	1.90	1.82	1.67	1.67	1.84	1.90	2.06	1.62	2.00
Wesleyan & General	1.51	1.96	2.52	1.91	1.29	.99	1.12	.51	.50	.00	.00	.00
Total	1.27	1.55	2.40	2.18	2.08	2.04	2.04	2.11	2.17	2.37	2.16	2.00

* For these companies separate Comp data were available.

Risk group : MOTOR - COMPREHENSIVE

Method : BASIC CHAIN LADDER

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	31691	647	229	35	31	22	21	7	2	2	4	0	0
Britannic	11180	626	228	34	30	32	10	12	2	1	5	17	3
Commercial Union	264077	648	223	35	29	28	15	10	5	1	1	1	2
Co-operative	239737	614	222	39	36	27	20	15	9	7	2	2	10
Cornhill	206572	610	232	38	36	25	20	12	7	7	5	3	7
Eagle Star *	326819	626	231	40	33	26	14	9	9	6	3	0	1
General Accident	594874	621	234	35	31	18	16	13	9	7	2	5	8
Guardian Royal	515861	635	235	43	34	19	15	9	4	3	2	0	0
Iron Trades Mutual *	183011	638	227	36	34	24	23	7	4	5	1	0	0
Legal & General	73122	602	253	35	31	24	22	13	10	4	1	3	2
London & Edinburgh	76420	590	253	42	46	18	20	18	8	2	0	1	1
National Employers Mutual	83565	617	223	36	39	25	16	12	16	14	1	1	0
National Farmers Union Mutual	118677	606	221	35	41	32	19	18	10	10	8	0	0
National Insurance & Guarantee	138462	612	255	41	32	28	16	8	6	2	0	0	1
Norman *	20622	599	235	41	49	25	23	7	6	15	0	0	0
Norwich Union *	306017	582	280	39	36	28	14	10	8	2	0	0	0
Pearl	42718	581	240	58	52	27	29	9	3	0	1	0	0
Provincial	158504	612	239	42	37	23	16	14	6	6	1	3	1
Prudential	250410	624	238	37	30	27	16	11	6	3	4	1	5
Royal *	361770	623	227	43	36	28	17	14	5	4	1	1	2
Sun Alliance & London	550728	627	246	40	34	20	15	9	4	2	1	1	1
Wesleyan & General	6389	576	211	33	36	64	56	9	15	0	0	0	0
Total	4561226	622	237	39	33	23	17	11	7	4	2	2	3

* For these companies separate Comp data were available.

Risk group : MOTOR - COMPREHENSIVE

Method : BASIC CHAIN LADDER

MEAN TERM

Name	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	1.19	1.47	2.26	1.95	1.72	1.44	1.72	1.69	1.12	.50	.00	.00
Britannic	1.41	1.94	3.18	2.98	2.90	3.40	3.13	3.27	2.46	1.56	.82	2.00
Commercial Union	1.23	1.56	2.40	2.12	1.84	1.88	1.88	2.20	2.85	2.59	2.34	2.00
Co-operative	1.47	2.02	3.07	2.85	2.78	2.76	2.78	2.93	3.00	3.20	2.60	2.00
Cornhill	1.45	1.92	3.00	2.80	2.77	2.70	2.79	2.76	2.46	2.37	2.33	2.00
Eagle Star *	1.29	1.62	2.45	2.23	2.06	2.00	1.76	1.36	1.13	1.15	2.44	2.00
General Accident	1.43	1.95	3.27	3.14	3.17	2.97	2.84	2.82	2.71	2.65	2.03	2.00
Guardian Royal	1.20	1.43	2.12	1.93	1.87	1.64	1.53	1.42	1.13	1.10	2.76	2.00
Iron Trades Mutual *	1.24	1.54	2.29	1.95	1.70	1.41	1.62	1.34	.83	1.09	.98	2.00
Legal & General	1.36	1.67	2.71	2.42	2.19	1.93	1.89	1.78	2.09	2.10	1.54	2.00
London & Edinburgh	1.35	1.58	2.32	1.98	1.99	1.51	1.20	1.21	1.73	2.06	1.28	2.00
National Employers Mutual	1.41	1.86	2.77	2.43	2.32	2.09	1.66	1.11	.69	.98	.70	2.00
National Farmers Union Mutual	1.47	1.96	2.81	2.40	2.20	2.04	1.66	1.41	.93	.51	-.10	2.00
National Insurance & Guarantee	1.24	1.40	2.12	1.83	1.53	1.44	1.38	1.20	1.81	3.26	3.00	2.00
Norman *	1.38	1.70	2.41	2.04	2.04	1.78	1.80	1.22	.50	.00	.00	.00
Norwich Union *	1.28	1.37	2.16	1.83	1.60	1.49	1.18	.80	.88	3.31	1.93	2.00
Pearl	1.36	1.54	1.94	1.62	1.45	1.04	1.19	1.29	1.81	1.04	.95	2.00
Provincial	1.33	1.63	2.45	2.21	2.12	1.94	1.69	1.73	1.41	1.55	.85	2.00
Prudential	1.32	1.68	2.72	2.54	2.39	2.50	2.59	2.77	2.77	2.35	2.55	2.00
Royal *	1.31	1.64	2.37	2.11	1.90	1.79	1.64	1.85	1.74	2.30	2.41	2.00
Sun Alliance & London	1.21	1.42	2.19	1.97	1.90	1.74	1.76	1.92	2.00	2.13	1.65	2.00
Wesleyan & General	1.58	2.05	2.59	1.97	1.34	1.00	1.15	.52	.50	.00	.00	.00
Total	1.32	1.66	2.61	2.41	2.32	2.24	2.23	2.30	2.34	2.45	2.17	2.00

* For these companies separate Comp data were available.

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	31691	619	224	36	33	24	28	14	8	6	5	0	2
Britannic	11180	632	237	34	28	25	8	13	2	2	6	11	3
Commercial Union	264077	648	227	36	28	26	15	10	6	2	2	1	1
Co-operative	239737	586	212	37	36	30	25	22	14	12	3	4	19
Cornhill	206572	618	236	39	35	25	20	10	5	5	3	1	4
Eagle Star *	326819	617	232	42	35	27	16	12	7	5	4	0	1
General Accident	594874	618	239	36	32	22	17	15	8	6	2	2	4
Guardian Royal	515861	628	233	42	34	23	18	10	5	4	2	0	1
Iron Trades Mutual *	183011	600	244	43	35	25	19	9	5	4	1	12	3
Legal & General	73122	576	247	38	32	28	38	18	11	4	1	4	3
London & Edinburgh	76420	582	257	42	42	20	19	26	7	2	0	1	1
National Employers Mutual	83565	632	236	35	32	22	11	10	10	9	1	1	0
National Farmers Union Mutual	118677	588	219	37	42	34	24	22	13	9	6	9	-2
National Insurance & Guarantee	138462	595	251	43	32	29	21	10	11	4	1	0	3
Norman *	20622	605	240	40	46	24	23	6	3	8	1	1	3
Norwich Union *	306017	578	275	40	38	29	14	10	7	7	0	1	1
Pearl	42718	566	238	53	46	30	37	11	8	1	3	5	1
Provincial	158504	616	239	40	35	24	15	14	6	6	1	3	0
Prudential	250410	634	241	36	25	23	14	8	6	3	4	1	6
Royal *	361770	612	227	43	37	29	17	17	6	5	1	1	3
Sun Alliance & London	550728	609	244	42	35	25	19	12	6	4	1	2	1
Wesleyan & General	6389	610	215	29	24	41	57	9	14	-1	0	0	3
Total	4561226	612	238	39	33	25	19	13	7	5	2	2	4

* For these companies separate Comp data were available.

Risk group : MOTOR - COMPREHENSIVE

Method : COMPANY INCURRED

MEAN TERM

Name	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	1.40	1.85	2.78	2.46	2.20	1.84	1.89	1.77	1.56	1.45	3.00	2.00
Britannic	1.34	1.77	3.04	2.93	2.91	3.23	2.84	3.14	2.37	1.54	1.02	2.00
Commercial Union	1.21	1.52	2.37	2.11	1.84	1.81	1.71	1.77	1.98	1.77	1.70	2.00
Co-operative	1.77	2.56	3.72	3.45	3.27	3.12	3.00	3.08	3.05	3.21	2.59	2.00
Cornhill	1.34	1.69	2.61	2.36	2.25	2.17	2.41	2.49	2.27	2.38	2.30	2.00
Eagle Star *	1.33	1.67	2.47	2.23	2.04	1.95	1.72	1.55	1.29	1.10	2.51	2.00
General Accident	1.36	1.74	2.81	2.60	2.49	2.30	2.16	2.28	2.28	2.53	2.10	2.00
Guardian Royal	1.26	1.53	2.27	2.02	1.86	1.66	1.65	1.66	1.46	1.86	2.78	2.00
Iron Trades Mutual *	1.42	1.80	2.84	2.72	2.71	2.73	2.97	2.78	2.39	1.90	.99	2.00
Legal & General	1.52	1.91	2.87	2.53	2.13	1.72	1.86	1.91	2.24	2.12	1.50	2.00
London & Edinburgh	1.39	1.64	2.45	2.14	2.04	1.59	1.14	1.49	1.94	2.05	1.39	2.00
National Employers Mutual	1.27	1.60	2.56	2.31	2.20	2.08	1.62	1.16	.78	1.05	.73	2.00
National Farmers Union Mutual	1.58	2.14	2.99	2.57	2.33	2.10	1.78	1.59	1.23	.75	-.04	2.00
National Insurance & Guarantee	1.36	1.64	2.49	2.27	1.99	1.86	1.89	1.67	2.32	3.19	3.00	2.00
Norman *	1.34	1.63	2.39	2.04	2.08	1.93	2.44	2.18	1.65	2.80	2.38	2.00
Norwich Union *	1.34	1.48	2.33	2.01	1.85	1.84	1.61	1.33	1.00	3.21	1.95	2.00
Pearl	1.50	1.81	2.41	2.13	1.92	1.57	1.99	1.96	2.16	1.44	.90	2.00
Provincial	1.32	1.64	2.50	2.26	2.14	1.99	1.70	1.72	1.37	1.51	.79	2.00
Prudential	1.28	1.62	2.79	2.71	2.60	2.75	2.91	2.87	2.87	2.42	2.52	2.00
Royal *	1.37	1.75	2.52	2.26	2.08	1.99	1.76	2.09	2.03	2.78	2.52	2.00
Sun Alliance & London	1.32	1.59	2.42	2.17	1.99	1.80	1.75	1.81	1.82	1.98	1.64	2.00
Wesleyan & General	1.47	1.99	2.81	2.27	1.61	1.17	1.73	1.41	6.23	4.00	3.00	2.00
Total	1.36	1.73	2.68	2.46	2.31	2.19	2.15	2.23	2.24	2.38	2.14	2.00

* For these companies separate Comp data were available.

Risk group : MOTOR - NON COMPREHENSIVE

Method : INFLATION ADJUSTED CHAIN LADDER

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	9107	400	231	99	116	50	62	19	7	6	9	0	0
Britannic	2832	236	214	102	185	93	42	44	6	5	17	46	11
Commercial Union	20396	299	252	153	114	94	44	25	12	3	2	1	1
Co-operative	43687	244	231	128	114	91	62	46	27	20	5	5	26
Cornhill	22891	305	254	132	100	82	52	25	14	14	8	4	9
Eagle Star *	36853	247	225	141	132	79	65	42	22	7	9	4	27
General Accident	78319	277	233	118	107	94	55	41	25	18	6	9	17
Guardian Royal	89878	259	280	155	121	89	48	24	11	9	3	0	0
Iron Trades Mutual *	27671	345	257	91	111	83	57	22	16	10	1	0	5
Legal & General	5869	246	223	114	156	61	80	48	37	13	5	10	7
London & Edinburgh	50816	320	260	113	107	71	53	43	21	5	1	3	1
National Employers Mutual	6403	304	263	142	88	73	39	27	33	27	2	2	0
National Farmers Union Mutual	17580	294	215	103	142	78	50	49	28	25	17	1	0
National Insurance & Guarantee	44045	311	279	123	109	80	49	23	18	5	1	0	2
Norman *	769	397	319	61	69	25	7	31	92	0	0	0	0
Norwich Union *	76576	281	228	123	114	90	71	34	18	17	8	11	4
Pearl	5869	213	219	207	113	131	81	23	9	1	2	1	0
Provincial	19609	269	241	142	128	72	53	42	19	19	3	10	1
Prudential	27515	303	252	123	110	73	50	33	18	8	13	3	15
Royal *	26999	281	274	152	109	83	55	23	15	6	2	1	0
Sun Alliance & London	89025	291	260	157	106	79	49	29	13	7	2	4	3
Wesleyan & General	989	316	188	123	97	119	110	18	29	0	0	0	0
Total	703698	286	252	132	113	83	53	33	19	12	5	4	8

* For these companies separate Non-comp data were available.

MEAN TERM

Name	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	2.08	2.14	2.17	1.78	1.75	1.36	1.64	1.60	1.08	.50	.00	.00
Britannic	3.14	2.96	2.92	2.47	2.85	3.13	3.00	3.31	2.51	1.64	.97	2.00
Commercial Union	2.29	2.05	1.92	1.66	1.40	1.36	1.24	1.23	1.61	1.49	1.65	2.00
Co-operative	3.05	2.87	2.92	2.71	2.60	2.60	2.61	2.79	2.88	3.15	2.58	2.00
Cornhill	2.49	2.37	2.45	2.28	2.14	2.21	2.39	2.37	2.12	2.19	2.30	2.00
Eagle Star *	2.96	2.77	2.74	2.56	2.62	2.56	2.78	3.17	3.42	2.97	2.66	2.00
General Accident	2.86	2.76	2.84	2.59	2.42	2.49	2.43	2.48	2.49	2.66	2.13	2.00
Guardian Royal	2.38	2.03	1.96	1.71	1.49	1.42	1.36	1.25	.92	.89	2.75	2.00
Iron Trades Mutual *	2.29	2.24	2.37	1.92	1.73	1.65	1.84	1.76	1.97	3.35	3.00	2.00
Legal & General	2.94	2.73	2.68	2.27	2.34	1.90	1.84	1.73	2.07	2.07	1.53	2.00
London & Edinburgh	2.36	2.23	2.31	1.98	1.78	1.50	1.21	1.19	1.66	2.05	1.29	2.00
National Employers Mutual	2.45	2.30	2.39	2.31	2.09	1.98	1.61	1.08	.69	1.01	.69	2.00
National Farmers Union Mutual	2.75	2.68	2.64	2.20	2.19	1.97	1.59	1.35	.92	.51	-.25	2.00
National Insurance & Guarantee	2.25	2.04	2.09	1.77	1.55	1.43	1.37	1.18	1.85	3.30	3.00	2.00
Norman *	2.11	2.17	3.04	2.74	2.73	2.16	1.25	.50	.00	.00	.00	.00
Norwich Union *	2.73	2.60	2.58	2.28	2.08	1.95	2.08	1.99	1.66	1.55	1.14	2.00
Pearl	2.64	2.22	1.88	1.67	1.21	.99	1.11	1.18	1.83	1.16	.90	2.00
Provincial	2.65	2.44	2.39	2.16	2.13	1.93	1.72	1.70	1.39	1.53	.82	2.00
Prudential	2.59	2.49	2.62	2.43	2.43	2.44	2.52	2.69	2.72	2.29	2.55	2.00
Royal *	2.33	2.04	1.99	1.75	1.50	1.32	1.29	1.05	.99	.94	.76	2.00
Sun Alliance & London	2.37	2.14	2.08	1.93	1.75	1.67	1.67	1.84	1.90	2.06	1.62	2.00
Wesleyan & General	2.56	2.52	2.28	1.87	1.35	.99	1.12	.51	.50	.00	.00	.00
Total	2.56	2.39	2.41	2.18	2.06	2.04	2.04	2.11	2.17	2.37	2.16	2.00

* For these companies separate Non-comp data were available.

Risk group : MOTOR - NON COMPREHENSIVE

Method : BASIC CHAIN LADDER

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	9107	403	226	93	115	49	66	21	7	7	12	0	0
Britannic	2832	231	208	100	166	88	42	50	7	5	20	72	11
Commercial Union	20396	288	241	147	108	89	53	36	18	5	4	3	8
Co-operative	43687	240	229	126	110	91	63	47	28	21	6	6	32
Cornhill	22891	289	242	126	96	76	57	34	19	19	14	7	20
Eagle Star *	36853	241	222	138	130	79	69	44	23	8	10	4	30
General Accident	78319	258	219	110	98	87	59	50	33	26	9	20	31
Guardian Royal	89878	252	273	149	116	85	55	33	16	13	7	0	1
Iron Trades Mutual *	27671	349	253	91	110	81	57	24	16	13	1	0	6
Legal & General	5869	243	224	114	152	59	84	49	39	15	5	11	8
London & Edinburgh	50816	315	255	111	107	71	57	49	23	6	1	3	1
National Employers Mutual	6403	300	257	139	85	73	39	30	38	35	3	2	0
National Farmers Union Mutual	17580	292	209	100	136	76	54	52	30	29	22	1	0
National Insurance & Guarantee	44045	308	278	122	110	80	51	25	18	5	1	0	2
Norman *	769	382	320	59	74	31	6	35	93	0	0	0	0
Norwich Union *	76576	274	226	121	112	89	75	36	20	21	9	13	4
Pearl	5869	212	217	205	111	127	87	26	10	1	3	1	0
Provincial	19609	269	240	140	127	71	52	47	19	19	3	10	2
Prudential	27515	301	251	121	109	73	51	34	18	8	13	4	17
Royal *	26999	265	266	148	116	90	61	25	18	7	2	1	0
Sun Alliance & London	89025	291	259	155	104	78	50	30	14	8	3	4	4
Wesleyan & General	989	319	184	120	96	113	117	19	32	1	0	0	0
Total	703698	280	247	128	110	80	56	38	22	15	6	6	12

* For these companies separate Non-comp data were available.

MEAN TERM

Name	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	2.13	2.23	2.29	1.89	1.86	1.44	1.72	1.69	1.12	.50	.00	.00
Britannic	3.40	3.26	3.29	2.89	3.24	3.40	3.13	3.27	2.46	1.56	.82	2.00
Commercial Union	2.52	2.34	2.28	2.09	1.89	1.88	1.88	2.20	2.85	2.59	2.34	2.00
Co-operative	3.15	2.99	3.06	2.86	2.75	2.76	2.78	2.93	3.00	3.20	2.60	2.00
Cornhill	2.82	2.76	2.92	2.81	2.71	2.70	2.79	2.76	2.46	2.37	2.33	2.00
Eagle Star *	3.05	2.86	2.84	2.66	2.71	2.63	2.86	3.23	3.43	2.98	2.68	2.00
General Accident	3.29	3.26	3.41	3.19	3.02	2.97	2.84	2.82	2.71	2.65	2.03	2.00
Guardian Royal	2.53	2.22	2.20	1.97	1.78	1.64	1.53	1.42	1.13	1.10	2.76	2.00
Iron Trades Mutual *	2.32	2.29	2.43	2.00	1.83	1.74	1.92	1.88	1.95	3.34	3.00	2.00
Legal & General	2.98	2.78	2.74	2.34	2.39	1.93	1.89	1.78	2.09	2.10	1.54	2.00
London & Edinburgh	2.43	2.31	2.39	2.05	1.84	1.51	1.20	1.21	1.73	2.06	1.28	2.00
National Employers Mutual	2.54	2.42	2.54	2.46	2.23	2.09	1.66	1.11	.69	.98	.70	2.00
National Farmers Union Mutual	2.85	2.82	2.78	2.35	2.31	2.04	1.66	1.41	.93	.51	-.10	2.00
National Insurance & Guarantee	2.28	2.07	2.12	1.80	1.59	1.44	1.38	1.20	1.81	3.26	3.00	2.00
Norman *	2.17	2.21	3.04	2.68	2.66	2.15	1.23	.50	.00	.00	.00	.00
Norwich Union *	2.82	2.70	2.69	2.39	2.18	2.02	2.13	2.01	1.66	1.57	1.15	2.00
Pearl	2.68	2.27	1.94	1.74	1.28	1.04	1.19	1.29	1.81	1.04	.95	2.00
Provincial	2.67	2.47	2.43	2.20	2.16	1.94	1.69	1.73	1.41	1.55	.85	2.00
Prudential	2.63	2.54	2.69	2.50	2.50	2.50	2.59	2.77	2.77	2.35	2.55	2.00
Royal *	2.44	2.14	2.08	1.81	1.54	1.36	1.34	1.05	.98	.95	.75	2.00
Sun Alliance & London	2.40	2.17	2.14	2.00	1.82	1.74	1.76	1.92	2.00	2.13	1.65	2.00
Wesleyan & General	2.59	2.57	2.34	1.92	1.40	1.00	1.15	.52	.50	.00	.00	.00
Total	2.70	2.55	2.62	2.41	2.30	2.24	2.23	2.30	2.34	2.45	2.17	2.00

* For these companies separate Non-comp data were available.

Risk group : MOTOR - NON COMPREHENSIVE　　　　　Method : COMPANY INCURRED

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	9107	366	212	79	85	55	65	53	33	24	21	0	8
Britannic	2832	267	217	91	103	107	43	59	9	9	30	51	14
Commercial Union	20396	307	250	148	103	80	44	30	18	7	5	4	3
Co-operative	43687	221	206	113	98	87	65	60	41	34	9	11	55
Cornhill	22891	302	265	139	114	79	43	21	10	10	5	3	8
Eagle Star *	36853	247	226	140	129	78	67	47	25	8	8	5	20
General Accident	78319	278	236	114	95	86	64	47	28	21	7	8	15
Guardian Royal	89878	253	270	152	123	87	54	29	13	11	4	0	3
Iron Trades Mutual *	27671	364	228	88	105	91	61	16	25	7	3	0	12
Legal & General	5869	237	223	121	168	69	76	46	29	10	4	10	7
London & Edinburgh	50816	338	278	115	105	61	41	33	17	5	1	3	2
National Employers Mutual	6403	343	264	132	81	52	22	29	38	33	4	3	0
National Farmers Union Mutual	17580	284	215	97	139	82	54	51	29	21	13	19	-3
National Insurance & Guarantee	44045	284	257	118	104	90	57	33	33	12	3	0	9
Norman *	769	367	326	52	69	20	7	16	84	0	12	12	35
Norwich Union *	76576	277	224	122	114	93	75	37	21	16	10	8	3
Pearl	5869	205	206	175	104	119	99	45	21	4	7	12	2
Provincial	19609	269	235	141	125	83	56	37	19	21	3	11	1
Prudential	27515	318	274	124	101	66	41	24	15	7	11	4	15
Royal *	26999	249	251	148	110	91	62	30	22	17	13	4	1
Sun Alliance & London	89025	271	248	153	110	84	57	35	18	11	4	5	4
Wesleyan & General	989	392	218	102	73	97	69	13	31	-1	0	0	6
Total	703698	278	244	127	108	82	58	39	23	16	7	6	11

* For these companies separate Non-comp data were available.

Risk group : MOTOR - NON COMPREHENSIVE

Method : COMPANY INCURRED

MEAN TERM

Name	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	2.69	2.96	3.19	2.81	2.57	2.14	1.90	1.77	1.56	1.45	3.00	2.00
Britannic	3.29	3.31	3.49	3.13	2.98	3.20	2.88	3.14	2.37	1.54	1.02	2.00
Commercial Union	2.39	2.22	2.19	2.04	1.87	1.86	1.76	1.77	1.98	1.77	1.70	2.00
Co-operative	3.70	3.61	3.73	3.52	3.33	3.22	3.06	3.08	3.05	3.21	2.59	2.00
Cornhill	2.37	2.19	2.22	2.03	2.00	2.17	2.40	2.49	2.27	2.38	2.30	2.00
Eagle Star *	2.93	2.73	2.68	2.47	2.47	2.31	2.40	2.76	3.12	2.76	2.50	2.00
General Accident	2.89	2.82	2.94	2.69	2.44	2.33	2.25	2.28	2.29	2.53	2.10	2.00
Guardian Royal	2.49	2.17	2.12	1.88	1.71	1.63	1.62	1.66	1.46	1.86	2.78	2.00
Iron Trades Mutual *	2.39	2.47	2.57	2.15	1.95	2.02	2.50	2.18	3.06	3.32	3.00	2.00
Legal & General	2.90	2.65	2.54	2.12	2.21	1.86	1.85	1.91	2.24	2.12	1.50	2.00
London & Edinburgh	2.20	2.07	2.20	1.93	1.84	1.65	1.43	1.49	1.94	2.05	1.39	2.00
National Employers Mutual	2.36	2.33	2.55	2.59	2.52	2.33	1.71	1.16	.78	1.05	.73	2.00
National Farmers Union Mutual	2.86	2.80	2.78	2.33	2.29	2.10	1.77	1.59	1.23	.75	-.04	2.00
National Insurance & Guarantee	2.61	2.45	2.55	2.25	2.02	1.96	1.88	1.67	2.32	3.19	3.00	2.00
Norman *	2.60	2.82	4.28	4.05	4.38	3.84	2.99	2.26	3.80	2.80	2.38	2.00
Norwich Union *	2.77	2.64	2.59	2.27	2.03	1.86	1.93	1.84	1.58	1.38	1.16	2.00
Pearl	3.00	2.65	2.40	2.21	1.78	1.59	1.75	1.96	2.16	1.44	.90	2.00
Provincial	2.68	2.48	2.41	2.17	2.07	1.95	1.83	1.72	1.37	1.51	.79	2.00
Prudential	2.43	2.33	2.55	2.44	2.51	2.65	2.80	2.87	2.87	2.42	2.52	2.00
Royal *	2.70	2.43	2.40	2.20	1.98	1.88	1.85	1.55	1.21	.89	.92	2.00
Sun Alliance & London	2.57	2.33	2.28	2.11	1.91	1.79	1.75	1.81	1.82	1.98	1.64	2.00
Wesleyan & General	2.24	2.36	2.40	2.06	1.60	1.50	1.89	1.41	6.23	4.00	3.00	2.00
Total	2.73	2.59	2.65	2.43	2.30	2.22	2.19	2.23	2.24	2.38	2.14	2.00

* For these companies separate Non-comp data were available.

ASSUMED MEAN TERM FOR OUTSTANDING : SENSITIVITY ANALYSIS

BASED ON EACH RISK GROUP'S AGGREGATE DATA

Method : INFLATION ADJUSTED CHAIN LADDER

Risk group : FIRE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7+
1	1.31	1.11	1.60	1.96	2.29	2.41	1.90	1.00
Diff	-.02	-.03	-.11	-.24	-.46	-.74	-.94	-1.00
2	1.33	1.14	1.70	2.20	2.75	3.15	2.84	2.00
3	1.35	1.17	1.81	2.44	3.20	3.89	3.77	3.00
Diff	.02	.03	.11	.24	.46	.74	.94	1.00
4	1.36	1.20	1.92	2.68	3.66	4.63	4.71	4.00
Diff	.03	.06	.21	.48	.91	1.48	1.87	2.00

Risk group : EMPLOYERS LIABILITY

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
2	4.08	3.20	2.82	2.68	2.67	2.81	2.99	3.16	3.32	3.42	3.32	3.02	2.43	2.00
Diff	-.05	-.05	-.06	-.08	-.12	-.18	-.28	-.41	-.59	-.81	-1.06	-1.33	-1.54	-2.00
4	4.12	3.25	2.88	2.76	2.80	2.99	3.26	3.57	3.91	4.23	4.38	4.35	3.97	4.00
6	4.17	3.30	2.94	2.84	2.92	3.17	3.54	3.98	4.50	5.05	5.45	5.68	5.51	6.00
Diff	.05	.05	.06	.08	.12	.18	.28	.41	.59	.81	1.06	1.33	1.54	2.00
8	4.22	3.34	3.00	2.92	3.04	3.36	3.82	4.38	5.08	5.86	6.51	7.01	7.05	8.00
Diff	.09	.10	.12	.17	.24	.37	.55	.82	1.17	1.63	2.13	2.66	3.08	4.00

ASSUMED MEAN TERM FOR OUTSTANDING : SENSITIVITY ANALYSIS

BASED ON EACH RISK GROUP'S AGGREGATE DATA

Method : INFLATION ADJUSTED CHAIN LADDER

Risk group : MOTOR - COMPREHENSIVE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11+
1	1.27	1.55	2.39	2.16	2.06	2.00	1.97	1.98	1.93	1.93	1.51	1.00
Diff	.00	.00	-.01	-.01	-.02	-.04	-.07	-.13	-.24	-.43	-.64	-1.00
2	1.27	1.55	2.40	2.18	2.08	2.04	2.04	2.11	2.17	2.37	2.16	2.00
3	1.27	1.56	2.41	2.19	2.10	2.07	2.11	2.23	2.39	2.77	2.77	3.00
Diff	.00	.00	.01	.01	.02	.04	.06	.12	.22	.41	.62	1.00
4	1.27	1.56	2.42	2.20	2.12	2.10	2.16	2.34	2.58	3.15	3.36	4.00
Diff	.00	.00	.01	.02	.04	.07	.12	.22	.41	.78	1.21	2.00

Risk group : MOTOR - NON COMPREHENSIVE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11+
1	2.56	2.38	2.40	2.17	2.04	2.00	1.97	1.98	1.93	1.93	1.51	1.00
Diff	.00	-.01	-.01	-.01	-.02	-.04	-.07	-.13	-.24	-.43	-.64	-1.00
2	2.56	2.39	2.41	2.18	2.06	2.04	2.04	2.11	2.17	2.37	2.16	2.00
3	2.56	2.39	2.42	2.19	2.08	2.07	2.11	2.23	2.39	2.77	2.77	3.00
Diff	.00	.00	.01	.01	.02	.04	.06	.12	.22	.41	.62	1.00
4	2.56	2.39	2.43	2.20	2.10	2.10	2.16	2.34	2.58	3.15	3.36	4.00
Diff	.01	.01	.01	.02	.04	.07	.12	.22	.41	.78	1.21	2.00

ASSUMED MEAN TERM FOR OUTSTANDING : SENSITIVITY ANALYSIS

BASED ON EACH RISK GROUP'S AGGREGATE DATA

Risk group : FIRE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7+
1	1.27	1.07	1.55	1.93	2.29	2.42	1.91	1.00
Diff	-.01	-.08	-.10	-.24	-.46	-.75	-.94	-1.00
2	1.29	1.10	1.65	2.17	2.75	3.17	2.85	2.00
3	1.30	1.13	1.76	2.41	3.22	3.92	3.79	3.00
Diff	.01	.03	.10	.24	.46	.75	.94	1.00
4	1.31	1.16	1.86	2.64	3.68	4.67	4.73	4.00
Diff	.03	.06	.20	.47	.92	1.50	1.88	2.00

Risk group : EMPLOYERS LIABILITY

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
2	4.21	3.33	2.95	2.80	2.79	2.90	3.05	3.22	3.35	3.41	3.29	2.98	2.40	2.00
Diff	-.05	-.05	-.07	-.09	-.13	-.19	-.28	-.41	-.58	-.80	-1.04	-1.30	-1.52	-2.00
4	4.26	3.38	3.01	2.89	2.92	3.09	3.34	3.63	3.93	4.21	4.33	4.28	3.91	4.00
6	4.32	3.44	3.08	2.98	3.04	3.28	3.62	4.04	4.51	5.01	5.37	5.58	5.43	6.00
Diff	.05	.05	.07	.09	.13	.19	.28	.41	.58	.80	1.04	1.30	1.52	2.00
8	4.37	3.49	3.15	3.07	3.17	3.47	3.90	4.45	5.09	5.81	6.41	6.89	6.94	8.00
Diff	.11	.11	.13	.18	.26	.38	.56	.82	1.16	1.60	2.08	2.60	3.03	4.00

ASSUMED MEAN TERM FOR OUTSTANDING : SENSITIVITY ANALYSIS

BASED ON EACH RISK GROUP'S AGGREGATE DATA

Method : BASIC CHAIN LADDER

Risk group : MOTOR - COMPREHENSIVE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11+
1	1.31	1.65	2.58	2.37	2.27	2.16	2.11	2.11	2.03	1.96	1.50	1.00
Diff	.00	-.01	-.02	-.03	-.05	-.08	-.12	-.19	-.30	-.49	-.67	-1.00
2	1.32	1.66	2.61	2.41	2.32	2.24	2.23	2.30	2.34	2.45	2.17	2.00
3	1.32	1.67	2.63	2.44	2.37	2.32	2.35	2.49	2.64	2.94	2.84	3.00
Diff	.00	.01	.02	.03	.05	.08	.12	.19	.30	.49	.67	1.00
4	1.32	1.68	2.66	2.47	2.42	2.39	2.47	2.69	2.94	3.42	3.50	4.00
Diff	.01	.02	.05	.07	.10	.15	.24	.39	.61	.97	1.34	2.00

Risk group : MOTOR - NON COMPREHENSIVE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11+
1	2.68	2.54	2.60	2.38	2.25	2.16	2.11	2.11	2.03	1.96	1.50	1.00
Diff	-.01	-.02	-.02	-.03	-.05	-.08	-.12	-.19	-.30	-.49	-.67	-1.00
2	2.70	2.55	2.62	2.41	2.30	2.24	2.23	2.30	2.34	2.45	2.17	2.00
3	2.71	2.57	2.65	2.45	2.35	2.32	2.35	2.49	2.64	2.94	2.84	3.00
Diff	.01	.02	.02	.03	.05	.08	.12	.19	.30	.49	.67	1.00
4	2.72	2.58	2.67	2.48	2.40	2.39	2.47	2.69	2.94	3.42	3.50	4.00
Diff	.02	.03	.05	.07	.10	.15	.24	.39	.61	.97	1.34	2.00

ASSUMED MEAN TERM FOR OUTSTANDING : SENSITIVITY ANALYSIS

BASED ON EACH RISK GROUP'S AGGREGATE DATA

Method : AVERAGE CLAIM METHOD

Risk group : FIRE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7+
1	1.31	1.10	1.57	1.96	2.30	2.43	1.90	1.00
Diff	-.02	-.03	-.11	-.24	-.46	-.75	-.93	-1.00
2	1.33	1.13	1.68	2.20	2.76	3.19	2.84	2.00
3	1.35	1.16	1.78	2.45	3.22	3.94	3.77	3.00
Diff	.02	.03	.11	.24	.46	.75	.93	1.00
4	1.36	1.19	1.89	2.69	3.69	4.69	4.70	4.00
Diff	.03	.06	.21	.48	.92	1.50	1.87	2.00

Risk group : EMPLOYERS LIABILITY

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
2	4.07	3.19	2.79	2.65	2.64	2.78	2.96	3.14	3.32	3.41	3.30	3.00	2.40	2.00
Diff	-.05	-.05	-.06	-.08	-.12	-.18	-.27	-.40	-.58	-.80	-1.05	-1.31	-1.52	-2.00
4	4.11	3.23	2.85	2.73	2.76	2.95	3.23	3.54	3.89	4.21	4.35	4.30	3.92	4.00
6	4.16	3.28	2.91	2.81	2.88	3.13	3.50	3.94	4.47	5.01	5.40	5.61	5.43	6.00
Diff	.05	.05	.06	.08	.12	.18	.27	.40	.58	.80	1.05	1.31	1.52	2.00
8	4.20	3.33	2.97	2.89	2.99	3.31	3.77	4.34	5.05	5.81	6.44	6.92	6.95	8.00
Diff	.09	.09	.12	.16	.23	.36	.54	.80	1.15	1.60	2.09	2.62	3.04	4.00

ASSUMED MEAN TERM FOR OUTSTANDING : SENSITIVITY ANALYSIS

BASED ON EACH RISK GROUP'S AGGREGATE DATA

Risk group : FIRE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7+
1	1.36	1.16	1.66	1.97	2.20	2.27	1.87	1.00
Diff	-.02	-.03	-.11	-.23	-.42	-.68	-.92	-1.00
2	1.38	1.20	1.77	2.20	2.62	2.95	2.79	2.00
3	1.40	1.23	1.87	2.42	3.03	3.64	3.71	3.00
Diff	.02	.03	.11	.23	.42	.68	.92	1.00
4	1.42	1.26	1.98	2.65	3.45	4.32	4.62	4.00
Diff	.03	.07	.21	.46	.84	1.37	1.83	2.00

Risk group : EMPLOYERS LIABILITY

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
2	4.37	3.49	3.10	2.95	2.93	3.03	3.17	3.32	3.46	3.51	3.35	3.06	2.45	2.00
Diff	-.06	-.07	-.08	-.11	-.15	-.21	-.31	-.45	-.63	-.85	-1.08	-1.35	-1.56	-2.00
4	4.43	3.55	3.18	3.06	3.08	3.25	3.49	3.76	4.09	4.35	4.44	4.41	4.02	4.00
6	4.50	3.62	3.26	3.16	3.23	3.46	3.80	4.21	4.71	5.20	5.52	5.76	5.58	6.00
Diff	.06	.07	.08	.11	.15	.21	.31	.45	.63	.85	1.08	1.35	1.56	2.00
8	4.56	3.69	3.34	3.27	3.38	3.68	4.11	4.66	5.34	6.04	6.61	7.11	7.15	8.00
Diff	.13	.13	.16	.21	.30	.43	.62	.89	1.25	1.69	2.17	2.70	3.13	4.00

ASSUMED MEAN TERM FOR OUTSTANDING : SENSITIVITY ANALYSIS

BASED ON EACH RISK GROUP'S AGGREGATE DATA

Risk group : MOTOR - COMPREHENSIVE   Risk group : COMPANY INCURRED

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11+
1	1.36	1.72	2.66	2.42	2.26	2.12	2.04	2.05	1.96	1.91	1.48	1.00
Diff	.00	-.01	-.02	-.03	-.05	-.07	-.11	-.18	-.28	-.47	-.66	-1.00
2	1.36	1.73	2.68	2.46	2.31	2.19	2.15	2.23	2.24	2.38	2.14	2.00
3	1.37	1.73	2.70	2.49	2.35	2.25	2.26	2.40	2.52	2.85	2.79	3.00
Diff	.00	.01	.02	.03	.05	.07	.11	.18	.28	.47	.66	1.00
4	1.37	1.74	2.73	2.52	2.40	2.32	2.36	2.58	2.80	3.32	3.45	4.00
Diff	.01	.02	.05	.06	.09	.14	.22	.36	.56	.93	1.31	2.00

Risk group : MOTOR - NON COMPREHENSIVE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11+
1	2.72	2.57	2.63	2.40	2.25	2.15	2.08	2.05	1.96	1.91	1.48	1.00
Diff	-.01	-.02	-.02	-.03	-.05	-.07	-.11	-.18	-.28	-.47	-.66	-1.00
2	2.73	2.59	2.65	2.43	2.30	2.22	2.19	2.23	2.24	2.38	2.14	2.00
3	2.74	2.60	2.68	2.46	2.34	2.29	2.30	2.40	2.52	2.85	2.79	3.00
Diff	.01	.02	.02	.03	.05	.07	.11	.18	.28	.47	.66	1.00
4	2.75	2.62	2.70	2.50	2.39	2.36	2.41	2.58	2.80	3.32	3.45	4.00
Diff	.02	.03	.05	.06	.09	.14	.22	.36	.56	.93	1.31	2.00

ASSUMED FUTURE INFLATION : SENSITIVITY ANALYSIS

BASED ON EACH RISK GROUP'S AGGREGATE DATA

Method : INFLATION ADJUSTED CHAIN LADDER

Risk group : FIRE

Assumed future
Inflation rate

	0	1	2	3	4	5	6	7+
8.00%	495	358	82	31	13	4	1	16
7.00%	498	357	81	30	13	4	1	15
Diff	4	-1	-1	-1	0	0	0	-1
9.00%	491	359	83	32	14	5	1	16
Diff	-4	1	1	1	0	0	0	1

Risk group : EMPLOYERS LIABILITY

Assumed future
Inflation rate

	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
8.00%	33	181	213	181	135	87	55	35	23	14	9	5	7	24
7.00%	34	185	216	181	134	86	54	34	22	13	8	5	7	22
Diff	1	4	3	1	-1	-1	-1	-1	-1	-1	-1	0	-1	-2
9.00%	32	177	210	180	135	89	56	37	24	14	9	5	8	25
Diff	-1	-4	-3	-1	1	1	1	1	1	1	1	0	1	2

ASSUMED FUTURE INFLATION : SENSITIVITY ANALYSIS

BASED ON EACH RISK GROUP'S AGGREGATE DATA

Method : INFLATION ADJUSTED CHAIN LADDER

Risk group : MOTOR - COMPREHENSIVE

Assumed future
Inflation rate

	0	1	2	3	4	5	6	7	8	9	10	11+
8.00%	625	239	39	34	24	15	10	6	4	1	1	2
7.00%	630	238	39	33	23	15	9	5	3	1	1	2
Diff	4	-1	0	-1	-1	-1	0	0	0	0	0	0
9.00%	621	239	40	35	24	16	10	6	4	2	1	3
Diff	-4	0	0	1	1	1	0	0	0	0	0	0

Risk group : MOTOR - NON COMPREHENSIVE

Assumed future
Inflation rate

	0	1	2	3	4	5	6	7	8	9	10	11+
8.00%	286	252	132	113	83	53	33	19	12	5	4	8
7.00%	292	254	132	112	81	51	32	18	11	5	4	7
Diff	5	2	0	-1	-2	-1	-1	-1	-1	0	0	-1
9.00%	281	249	132	114	84	54	34	20	13	5	4	8
Diff	-5	-2	0	1	1	1	1	1	1	0	0	1

ASSUMED FUTURE INFLATION : SENSITIVITY ANALYSIS

BASED ON EACH RISK GROUP'S AGGREGATE DATA

Method : AVERAGE CLAIM

Risk group : FIRE

Assumed future Inflation rate

	0	1	2	3	4	5	6	7+
8.00%	490	364	83	31	13	4	1	15
7.00%	493	363	82	30	13	4	1	15
Diff	3	-1	-1	-1	0	0	0	-1
9.00%	486	364	84	31	13	4	1	16
Diff	-3	1	1	1	0	0	0	1

Risk group : EMPLOYERS LIABILITY

Assumed future Inflation rate

	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
8.00%	32	179	214	182	136	88	55	35	22	13	9	5	7	23
7.00%	34	183	217	183	135	87	54	34	21	13	8	5	7	21
Diff	1	4	3	1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1
9.00%	31	175	211	181	136	89	56	36	23	14	9	5	8	24
Diff	-1	-4	-3	-1	1	1	1	1	1	1	1	0	1	2

WEIGHTED MEAN TERMS (USING OUTSTANDING PROPORTIONS ON RUN-OFF PATTERN AS WEIGHTS)

Risk group : FIRE

METHOD	IACL	BCL	AVC	CI
Avon	2.88	2.78	2.84	2.73
Britannic	.57	.57	.57	.91
Commercial Union	1.43	1.37	1.44	1.71
Co-operative	1.28	1.24	1.37	1.75
Cornhill	1.32	1.27	1.33	1.79
Eagle Star	1.52	1.46	1.49	1.54
Ecclesiastical	2.48	2.38	2.35	2.97
Economic	1.19	1.17	1.04	1.09
General Accident	1.29	1.24	1.29	1.74
Guardian Royal	1.46	1.41	1.44	1.43
Ins Co of North America	.86	.86	.83	1.00
Iron Trades Mutual	.88	.86	.91	.89
Legal & General	1.72	1.65	1.57	.32
Minster	1.15	1.12	1.10	2.09
Municipal General	2.11	2.04	2.06	1.64
Municipal Mutual	1.90	1.86	1.90	1.85
National Employers Mutual	1.62	1.57	1.63	1.62
National Farmers Union Mutual	.70	.67	.68	.63
Norwich Union	1.23	1.18	1.20	.62
Provincial	1.70	1.64	1.72	1.20
Prudential	1.15	1.12	1.08	1.76
Refuge	.67	.66	.66	.99
Royal	.87	.85	.87	.68
Sun Alliance & London	1.42	1.38	1.38	1.42
Wesleyan & General	1.30	1.25	1.22	.67
Total	1.50	1.45	1.48	1.56

SENSITIVITY ANALYSIS OF AGGREGATE DATA

WEIGHTED MEAN TERM

BY ASSUMED MEAN TERM FOR TAIL

Assumed Mean term for tail	IACL	BCL	AVC	CI
1	1.37	1.32	1.35	1.42
2	1.50	1.45	1.48	1.56
3	1.64	1.58	1.62	1.70
4	1.78	1.71	1.75	1.84

WEIGHTED MEAN TERMS (USING OUTSTANDING PROPORTIONS ON RUN-OFF PATTERN AS WEIGHTS)

Risk group : EMPLOYERS LIABILITY

METHOD	IACL	BCL	AVC	CI
Avon	2.12	2.12	2.11	2.55
Commercial Union	2.22	2.28	2.21	2.48
Co-operative	2.40	2.46	2.36	2.75
Cornhill	2.25	2.31	2.19	3.65
Eagle Star	3.51	3.64	3.60	3.70
General Accident	3.00	3.10	2.65	2.99
Guardian Royal	2.82	2.91	2.56	2.81
Iron Trades Mutual	2.51	2.56	2.51	2.72
Iron Trades Employers	2.61	2.71	2.55	3.08
Legal & General	3.88	4.03	3.65	3.84
National Employers Mutual	3.38	3.52	3.50	3.31
Norwich Union	2.81	2.93	2.68	3.19
Orion	2.80	2.79	3.02	2.63
Pearl	3.76	3.84	3.86	3.86
Provincial	2.43	2.51	2.49	2.98
Prudential	2.29	2.31	2.27	2.54
Royal	4.62	4.84	4.54	4.56
Sun Alliance & London	3.26	3.38	3.03	3.88
Wesleyan & General	2.20	2.25	2.01	1.83
Total	3.10	3.22	3.07	3.39

SENSITIVITY ANALYSIS OF AGGREGATE DATA

WEIGHTED MEAN TERM

BY ASSUMED MEAN TERM FOR TAIL

Assumed Mean term for tail	IACL	BCL	AVC	CI
2	2.92	3.03	2.90	3.17
4	3.10	3.22	3.07	3.39
6	3.27	3.40	3.24	3.60
8	3.44	3.59	3.40	3.82

WEIGHTED MEAN TERMS (USING OUTSTANDING PROPORTIONS ON RUN-OFF PATTERN AS WEIGHTS)

Risk group : MOTOR COMPREHENSIVE

METHOD	IACL	BCL	AVC	CI
Avon	1.62	1.69		2.12
Britannic	2.25	2.51		2.37
Commercial Union	1.53	1.86		1.80
Co-operative	2.42	2.54		3.05
Cornhill	2.01	2.43		2.07
Eagle Star	1.82	1.90	1.89	1.93
General Accident	2.13	2.58		2.18
Guardian Royal	1.48	1.66		1.77
Iron Trades Mutual	1.65	1.73	1.61	2.30
Legal & General	1.96	2.02		2.17
London & Edinburgh	1.73	1.78		1.86
National Employers Mutual	1.98	2.10		1.90
National Farmers Union Mutual	2.03	2.14		2.28
National Insurance & Guarantee	1.58	1.60		1.94
Norman	1.77	1.89	1.74	1.92
Norwich Union	1.53	1.58	1.52	1.75
Pearl	1.54	1.60		1.97
Provincial	1.89	1.91		1.93
Prudential	2.11	2.16		2.20
Royal	1.79	1.88	1.78	2.02
Sun Alliance & London	1.66	1.70		1.88
Wesleyan & General	1.87	1.93		2.06
Total	1.89	2.06		2.11

SENSITIVITY ANALYSIS OF AGGREGATE DATA

WEIGHTED MEAN TERM

BY ASSUMED MEAN TERM FOR TAIL

Assumed Mean term for tail	IACL	BCL	AVC	CI
1	1.87	2.02		2.07
2	1.89	2.06		2.11
3	1.91	2.11		2.16
4	1.93	2.16		2.20

WEIGHTED MEAN TERMS (USING OUTSTANDING PROPORTIONS ON RUN-OFF PATTERN AS WEIGHTS)

Risk group : MOTOR - NON COMPREHENSIVE

METHOD	IACL	BCL	AVC	CI
Avon	1.95	2.04		2.69
Britannic	2.76	3.04		3.08
Commercial Union	1.82	2.20		2.10
Co-operative	2.73	2.91		3.41
Cornhill	2.31	2.77		2.16
Eagle Star	2.72	2.80	2.71	2.60
General Accident	2.61	3.11		2.66
Guardian Royal	1.84	2.04		2.00
Iron Trades Mutual	2.10	2.17	2.10	2.36
Legal & General	2.42	2.48		2.35
London & Edinburgh	2.04	2.10		1.99
National Employers Mutual	2.17	2.28		2.30
National Farmers Union Mutual	2.33	2.43		2.43
National Insurance & Guarantee	1.89	1.92		2.31
Norman	2.29	2.29	2.31	3.39
Norwich Union	2.36	2.44	2.13	2.35
Pearl	1.82	1.87		2.26
Provincial	2.23	2.26		2.25
Prudential	2.47	2.57		2.47
Royal	1.85	1.91	1.90	2.22
Sun Alliance & London	1.99	2.05		2.16
Wesleyan & General	2.01	2.04		2.15
Total	2.26	2.46		2.47

SENSITIVITY ANALYSIS OF AGGREGATE DATA

WEIGHTED MEAN TERM

BY ASSUMED MEAN TERM FOR TAIL

Assumed Mean term for tail	IACL	BCL	AVC	CI
1	2.23	2.40		2.42
2	2.26	2.46		2.47
3	2.28	2.52		2.53
4	2.30	2.58		2.59

SECTION D

D1   Graphs 1-4

D1.1   For each development year the 19, 22 or 25 incremental proportions were sorted. The averages of the second and third largest were plotted as the upper band, the averages of the second and third smallest were plotted as the lower band, while the middle values or averages of the two middle values were plotted as the median. The result is a sort of confidence band in that two of the proportions lie above, two below and the rest in between the limits of the band, for each development year.

D1.2   The observations of A14.3 and A15.3 are evident at a glance. Less obvious is the first observation of A13.2, but this is primarily due to the scale of graph 1 being four times larger than that of graph 2.

D2   Graphs 5-8

D2.1   The cumulative run-off patterns for all companies were plotted, with the exception of Wesleyan and General EL, since this risk group is so small that its run-off is very peculiar. The lines are unlabelled as it is not the intention to identify the run-offs of individual companies in these plots. Instead the object is to show the spread of run-offs.

D2.2   Again the observations of A14.3 and A15.3 are evident. Although the scales of the graphs are again different, the observation of A13.2 is this time more apparent.

D3   Graphs 9-12

D3.1 The aggregate run-off patterns produced by the four methods were plotted.

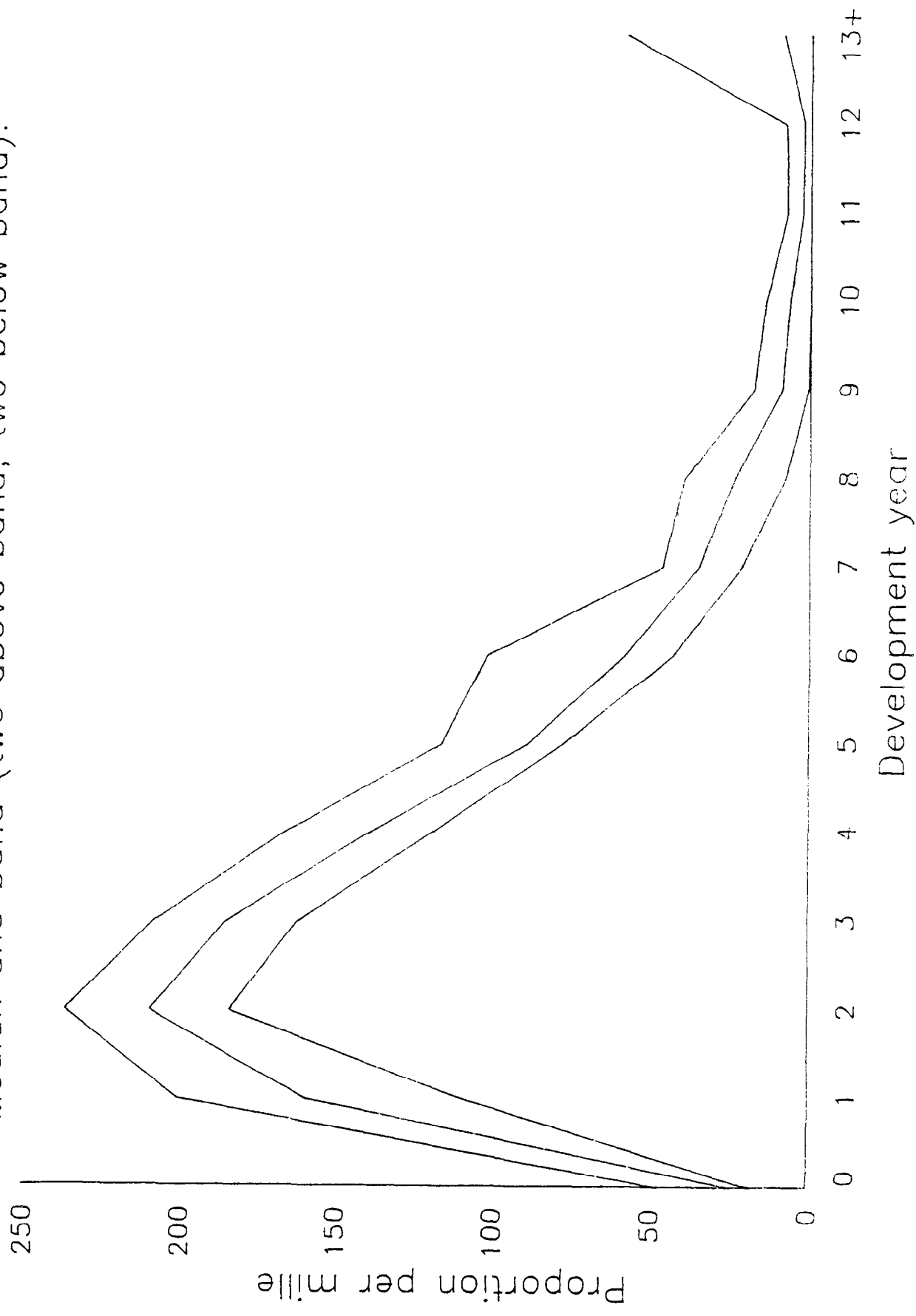D3.2 The similarity of results referred to in A16.1 is clear.

D4 Graphs 13-16

D4.1 The 18 (again omitting Wesleyan and General), 22 or 25 companies were divided into three equal groups according to size of risk group (the odd company being placed in the middle group). The run-off patterns for each group were then averaged and plotted.
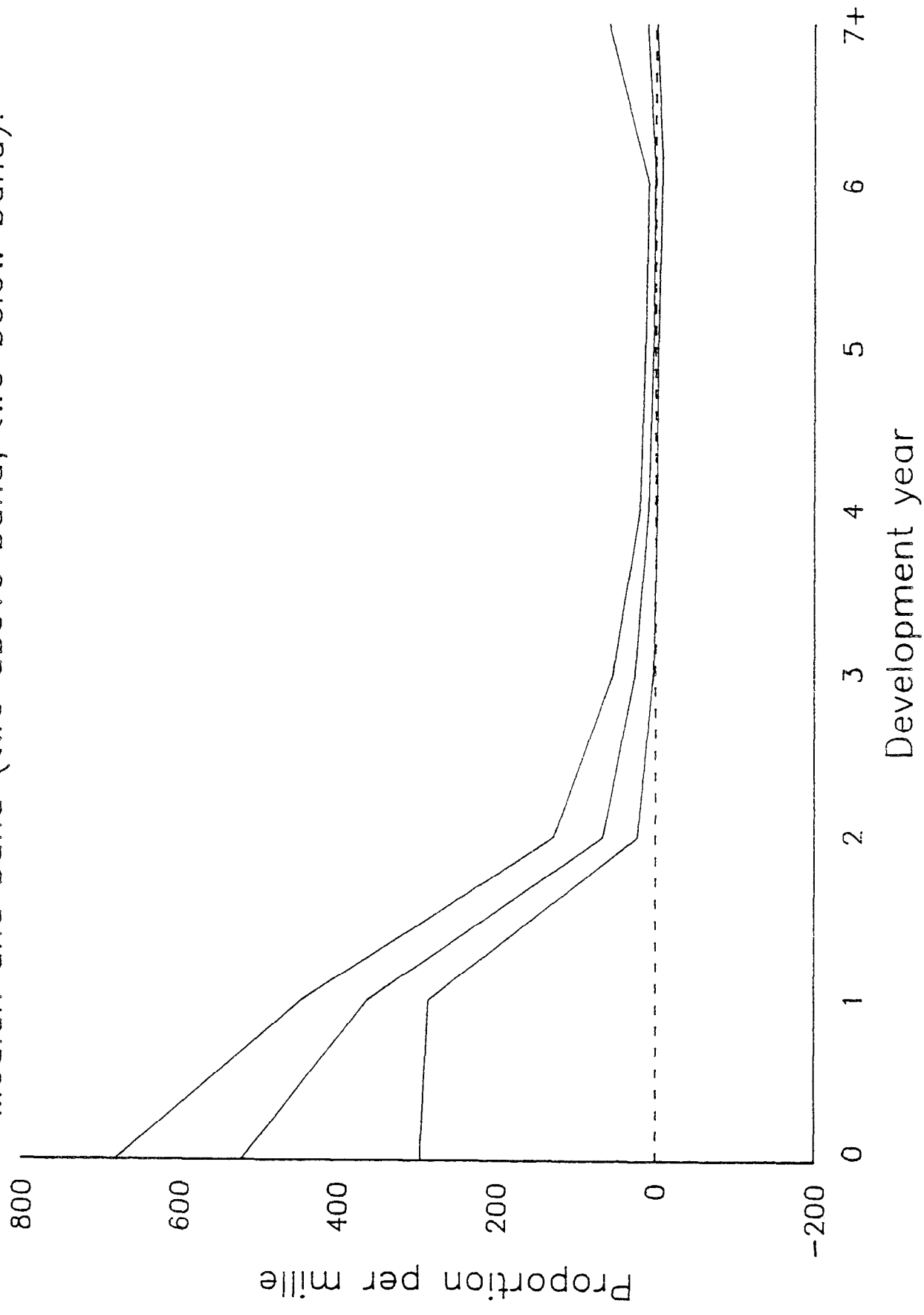
D4.2 Since variation within the groups is suppressed, the graphs necessarily represent a cruder test of the effect of risk group size upon run-off pattern than that performed for A17.3. Nevertheless, the conclusions of that paragraph are partly borne out: graph 16 demonstrates the absence of any size effect for non-comp motor; graphs 13 and 15 show the large risk groups above the others at the relevant point. Graph 13 also suggests that small companies have a smaller proportion of claims in the tail, but the analysis described in A17.3 indicated that this was not significant. Graph 14 shows an apparent size effect but this is swamped by variation between companies.

989-012

Graph 1. IACL Run-off — Employers Liability
Median and band (two above band, two below band).

Proportion per mille

Development year

Graph 2. IACL Run-off — – Fire
Median and band (two above band, two below band).

Graph 3. IACL Run-off -- Comprehensive Motor
Median and band (two above band, two below band).

Graph 4. IACL Run-off — Non-Comp. Motor
Median and band (two above band, two below band).

Graph 5. IACL Run-off — Employers Liability
All companies except W & G

Cumulative paid per mille

Development year

Graph 6. IACL Run-off − − Fire

All companies

Cumulative paid per mille

Development year

Graph 7. IACL Run-off — Comprehensive Motor

All companies

Cumulative paid per mille

1000
900
800
700
600
500

0   1   2   3   4   5   6   7   8   9   10   11+

Development year

Graph 8. IACL Run-off -- Non-Comp. Motor

All companies

Cumulative paid per mille

1000
800
600
400
200

0   1   2   3   4   5   6   7   8   9   10   11+

Development year

Graph 9. Run-offs -- -- Employers Liability
Aggregate data -- all four methods

Legend:
- IACL
- BCL
- AVC
- CI

Y-axis: Proportion per mille (0, 50, 100, 150, 200, 250)

X-axis: Developmen year (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13+)

Graph 10. Run-offs -- Fire
Aggregate data -- all four methods

IACL
BCL
AVC
CI

Development year

Proportion per mille

Graph 11. Run-offs -- Comprehensive Motor

Aggregate data -- all methods except average claim

Graph 12. Run-offs -- Non-Comp. Motor
Aggregate data -- all methods except average claim

IACL
BCL
CI

Proportion per mille

300
250
200
150
100
50
0

0   1   2   3   4   5   6   7   8   9   10   11+

Development year

Graph 13. IACL Run-off — Employers Liability

All companies (except W & G) grouped by size of risk group

Small —+—
Med. —□—
Big —×—

Cumulative per mille

Development year

Graph 14. IACL Run-off — Fire

All companies grouped by size of risk group

Legend:
+ — Small
□ — Medium
× — Large

Cumulative per mille (vertical axis): 400, 500, 600, 700, 800, 900, 1000

Development year (horizontal axis): 0, 1, 2, 3, 4, 5, 6, 7+

Graph 15. IACL Run-off -- Comp. Motor
All companies grouped by size of risk group

Legend:
- Small (+)
- Medium (□)
- Large (×)

X-axis: Development year (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11+)

Y-axis: Cumulative per mille (600, 700, 800, 900, 1000)

Graph 16. IACL Run-off -- Non-Comp. Motor

All companies grouped by size of risk group

Legend:
- + Small
- □ Medium
- ✕ Large

Y-axis: Cumulative per mille (200, 400, 600, 800, 1000)

X-axis: Development year (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11+)

STOCHASTIC CHAIN-LADDER MODELS

E1 Introduction

E1.1 Last year's interim report included some payment pattern "standard deviations" but these were derived in an ad-hoc fashion.

E1.2 This section considers a direct derivation of payment patterns and their associated standard errors in a formal statistical context using the stochastic chain ladder. It is the work of one member of the working party and has not been fully vetted by the other members of the CWP.

E1.3 The basic approach goes back to the paper by Kremer and is further explained in the Zehnwirth chapter in the Institute Claims Reserving Manual Vol 2.

E1.4 Such models have recently received a lot of attention by R Verrall and A Renshaw of the City University and this section would not have been written but for the collaboration of the writer with these two researchers. In particular the derivation of the standard errors is entirely due to R Verrall and will appear in his paper "Chain Ladder and Maximum Likelihood".

E1.5 All the calculations for this section have been done using a PC Spreadsheet package (SuperCalc 5) and this makes such methods widely available. All that is necessary is a matrix inversion and multiplication command and (ideally) a multiple regression command. Both the Lotus and Excel spreadsheets also have these features.

E1.6 The section will first consider, for completeness, statistical models in general then the particular model to be used for fitting the paid data, the derivation of the payment patterns and their standard errors. Results are then given for the EL risk group for both the Basic Chain Ladder and the Inflation Adjusted Chain Ladder stochastic models. Results for some other risk groups may be appended if time allows. Finally some observations and suggestions for future work in this area are given.

E2 Statistical Models

E2.1 Statistical models are used extensively elsewhere for three main reasons. To obtain a better understanding of the data, for smoothing and for prediction.

E2.2 It is generally accepted that no such model will ever be perfect. This does not imply that statistical models are not useful.

E2.3 The current widespread rejection of formal statistical modelling in claims analysis work in favour of algorithmic and hand smoothing methods is due, at least in part, to a perceived difficulty in actually carrying out the necessary calculations and a lack of the necessary statistical background and training.

2

E2.4 Statistical models allow a fair amount of judgement to be exercised in both the model and explanatory parameter choices and further by assigning weights to the data. These refinements may not have the intuitive appeal of hand-adjusting development factors through judgement which is so loved by actuaries.

E2.5 Formal modelling will include model testing or a goodness of fit check achieved via residual analysis, and this also facilitates the identification of outliers. More sophisticated validation can also be carried out as well as a calculation of estimates (both future payments and payment patterns) and their standard errors.

E2.6 Modelling is both an art and a science. There is no universally accepted simple measure to differentiate between competing models although various criteria exist in practice. Statisticians generally favour parsimonious models, that is models where terms (parameters) that are not necessary are excluded.

E2.7 Overparameterisation leads to too close an adherence to the actual data and the subsequent instability of projections. In the extreme we can always get a perfect fit by increasing the number of parameters to the number of points we are attempting to fit. A small change to a single data point can have a very dramatic impact however on any projected values.

E2.8 The basic chain ladder technique is considered overparameterised as it involves $2n-1$ parameters for an $n \times n$ triangle. We have a parameter for each of the n accident years and one for each of the $(n-1)$ development periods.

3

E2.9 The models considered here are the stochastic equivalent of the chain ladder and are therefore subject to the same shortcomings. The difference is in the way we fit the models and derive the coefficients. Less parameterised stochastic models can be fitted just as easily using these techniques but will not be considered here in any detail.

E2.10 Fitting statistical models usually requires an assumption about the distribution of the error term. In the models considered here we assume, after a log transformation, that the residuals are identically and normally distributed with mean zero. The regression fit uses least squares which under these conditions is equivalent to maximum likelihood.

E2.11 The error assumption is not strictly true for the claims run-off data sets considered here. These errors or residuals tend to fan out (increase) with development year. There is therefore some evidence of increasing variability with development period or "heteroscedasticity" in the run-off data which we do not attempt to overcome. We consider this a minor irritation in the payment pattern derivation affecting the tail where relatively little activity occurs. The possible impact of this effect on our results is indicated later.

E3 Payment patterns and the stochastic chain ladder

E3.1 As we are primarily concerned with the derivation of a payment pattern it is natural to try a model that explicitly incorporates such a pattern. This contrasts with the traditional methods used in the main body of this report which derive the payment patterns from factors used for loss projections.

E3.2 In the simplest case we will assume that the incremental paids Pij for accident year i and development year j are the product of an accident year parameter Ai and a development year parameter Bj.

That is

$$Pij = Ai \times Bj$$

E3.3 If we further insist that the Bj's sum to 1 then they are the payment pattern values we are looking for. The Ai's in this case represent total payments for the i'th accident year.

E3.4 To fit this model we first need to take logarithms so as to linearise the relationship and thus enable the use of linear modelling techniques.

E3.5 This logarithmic transformation has the added benefits of removing heterogeneity in the data and stabilising the severity variance. For more details on the model and the fitting please refer to the IoA Claims Reserving Manual Vol 2 pages 2 to 9.

E3.6 Logarithmic transformations are widely used in modelling elsewhere for exactly these reasons and so there is nothing new in what we are doing here. In fact this model is the stochastic equivalent of the chain ladder.

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E3.7 The main problem of such log-linear models comes when we attempt to move from the log-space in which the model is fitted back to the original space as is clearly necessary for reserve projection purposes. In simple terms averages in log-space are the logs of the geometric mean and not the usual arithmetic mean. A simple illustration is given below, although this is not necessary for deriving the claim payment patterns.

E3.8 Consider the average of the two numbers 3 and 5.

The usual answer, which is the arithmetic mean, is simply 4.

On the log scale the average of the logarithms is :

$$(\log_e 3 + \log_e 5)/2 = (\log_e 15)/2 = 1.354$$

If we now go back to our original space by exponentiating (ie take antilog) we obtain 3.873 and not 4.

E3.9 What we have done is to derive the geometric mean of 3 and 5 which is the square root of 15 (=3x5). To get back to something like the desired 4 we need to bring in an additional (correction) term which is possible if we assume a normal error term in the log-space. The correction term, which under these conditions is half the variance of the underlying normal distribution, comes from the basic relationship between the mean of the log-normal distribution and the mean and variance of its underlying normal distribution.

E3.10 A difficulty with logarithmic transformations arises with negative values which do occur occasionally in incremental claims data. One way to deal with such values is to add a sufficiently large constant to all the data values to make them all positive.

E3.11 The effects of such shifts of the origin have not been sufficiently researched at present to enable us to make categorical statements about the desirability of such additions.

E3.12 Negative values were not a particular problem in the Employers Liability data and in the few instances where such values were encountered the logarithm was set to zero. This was done for convenience rather than absolute correctness.

E4 Fitting on the log-scale

E4.1 Taking logarithms of the assumed equation we have

$$\text{Ln} \ (Pij) = \text{Ln} \ (Ai) + \text{Ln} \ (Bj) \qquad 0 <= i, \ j \ < n$$

or redefining

$$Y_{ij} = a_i + b_j + e_{ij} \qquad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where we have now shown the error term e_{ij} . We assume that the e_{ij} are normally distributed with mean zero and standard deviation σ which may be denoted by

$$e_{ij} \sim N \ (\ 0, \ \sigma^2 \ )$$

This sigma (σ) , which is referred to as the the standard error of the regression, is a particularly useful piece of information.

E4.2 The assumption that these errors are identically and normally distributed implies that in the original space the data (the incremental paid losses) are log-normally distributed.

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E4.3 This would indicate, due to the skewness of the log-normal distribution, that extreme (outlying) incremental payments will tend to be above rather than below expected payments. This feature is to be found in a lot of incremental paid claims data sets and may arise for instance when a very large claim payment is made. This provides some empirical support to our assumption that the log-linear model is appropriate.

E4.4 The actual derivation of the model parameters on the log-scale is now almost trivial.

E4.5 To solve we need to make our equations non-singular and we do this by setting b_o = 0 and so reducing the parameters to the 2n-1 parameters of the basic chain ladder model. We see later how we get back the first year development pattern.

E4.6 We obtain the parameter estimates and their standard errors on the log-scale by using the regression command in our spreadsheet. To do this we need to produce the model design matrix X.

E4.7 Each row of this matrix contains the coefficients of our parameters a_i and b_j given by the model formula (1) above. Thus each row entry is either zero or one depending on whether the parameter is or is not present in the value. We have a column for each of our 2n-1 parameters and a row for each of our data values Y_{ij}, that is n*(n+1)/2 rows.

E4.8 The independent variable vector is just the vector of the logarithms of the incremental paids Pij which we denoted by Y_{ij}.

E4.9 An example using the fire data of just one company is shown in Table E1. This should hopefully make all this clear.

E4.10 The table first shows the base data in the usual triangle format and then the way the data has been put in a column so that we can produce the model design matrix X and carry out the regression in our spreadsheet. Part c of the table contains the regression output as produced by the program. We have just inserted a line to identify the parameters. The program calculates the parameter coefficients and their standard errors.

E4.11 Note in particular the "Std Err of Y Est" figure of .1661762, which is the sigma (σ) referred to above. It is calculated simply as the square root of the sum of the squares of the residuals (their mean is zero) divided by the number of degrees of freedom (15) which equals the number of data points (28) less the number of parameters (13). The regression has in fact minimised the sum of the squares of these errors.

E4.12 We can interpret this sigma (σ) still further. Our assumption about this error term translates to a multiplicative or percentage error term in the original space.

E4.13 Thinking in terms of percentage differences of incremental paids and considering the later development periods where values are relatively small, experience tells us that such percentage differences in paids tend to increase, even after accident year effects are removed, resulting in a measure of so called heteroscedasticity.

E4.14 As all fitted data points contribute to the value of σ an extreme data value can impact this overall model standard error significantly especially in models with too few degrees of freedom that is in small triangles with lots of parameters. This happens with the shorter tail Fire and Motor triangles.

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E4.15 The likely impact of any heteroscedasticity to our results is a possible (small) overstatement in the standard errors of the earlier development year patterns and an understatement in the standard errors of the later development year patterns.

E4.16 These problems were not too pronounced with the Employers Liability data. (see also Chart E1).

E5 Payment patterns and their standard errors

E5.1 The payment pattern can be calculated easily from the development year coefficients b_j produced by the regression. We simply exponentiate these (taking antilogs) and scale so that they add up to 1. Remember that we need to bring in the zero development parameter b_o, which was assumed to be zero in the log space, to complete our pattern.

E5.2 The pattern derivation is now as follows.

Let S_j for $j=0$ to $j=6$ be the derived payment pattern where we define

$$S_j = exp(b_j) \ / \ sum((exp(b_k)) \quad \text{where sum is for } k=0 \text{ to } 6.$$

and remembering that b_o is equal to 0.

E5.3 Setting out the calculation in steps we have

Development parameters

	b_0	b_1	b_2	b_3	b_4	b_5	b_6
Coeffs	0	-.461	-2.175	-3.030	-3.692	-4.431	-5.922

(these are from the regression output)

Exp(Coeffs)	1	.631	.114	.048	.025	.012	.003

Scaling to add to 1 we have the payment pattern

pattern S_j	.546	.344	.062	.026	.014	.007	.001

For comparison purposes the Basic Chain Ladder derived pattern assuming no payments beyond development period 6 is :

pattern	.548	.341	.063	.027	.014	.006	.001

E5.4 The regression derived figures are very close to the Basic Chain Ladder derived pattern as was to be expected. The regression approach however enables us to obtain additional information, such as the standard errors of the pattern in this instance or of the reserve estimates (see Renshaw and Verrall) which the traditional chain ladder does not.

E5.5 Note that we have not attempted to fit a tail beyond the actual paid periods included in the data although this can be done by curve fitting these development coefficients or a subset of them.

E5.6 In this particular case the development coefficients (on log-scale) for b_2 to b_6 appear to lie reasonably close to a straight line, indicating that the incremental paids seem to decay exponentially during this period, and so a simpler model with less parameters (parsimony) could be fitted which would also enable an estimate of a tail beyond the triangle from the paid.

E5.7 A good start point for such modelling is always the plot of the log-incremental paids. These often produce straight looking lines beyond the first one or two or three development periods. (see also the IoA Manual Vol 2 paper 2 by B Ajne on exponential run-off). This is an area currently being investigated using regression techniques.

E5.8 Deriving the standard errors of the pattern is a much more complex process. As described below the computation requires a matrix product involving the partial derivatives matrix of the pattern transformation from the log-space to the original space (that is the relationship between the coefficients b_k and the pattern S_j's) and the development part of the variance-covariance matrix of the coefficients. For the details of this derivation we refer the reader to the Verrall paper. We will outline his results and demonstrate the calculations with our example. The pattern variances are to be found along the diagonal of the variance-covariance matrix of these S_j's , which we name V(S).

E5.9 Verrall shows that under maximum likelihood conditions, which are satisfied in our least squares model as we have assumed the errors to be independently and normally distributed, this matrix is given by the three matrix product:

$$V(S) = T' * V(b) * T$$

where the T is the matrix of the partial derivatives of the transformation from the b_k's to the S_j's, T' is its transpose which turns out to be the same, and $V(b)$ has the first row and column made up of zeros reflecting the initial fixing of b_0 and has for the rest of its elements the bottom right hand corner of the variance-covariance matrix of all the regression coefficients. This is given by

$$\sigma^2 (X'X)^{-1}$$

where X is the model design matrix.

E5.10 The partial derivatives matrix T is obtained from the definition of our pattern S_j. In our case T is a 7x7 matrix and we define the (j,m) element T_{jm} by

$$T_{jm} = \partial S_j / \partial b_m \quad \text{for j,m from 0 to 6.}$$

E5.11 Fortunately all these matrices are easy to compute especially as the partial derivatives matrix simplifies so that all elements are derived from the calculated pattern values and turns out to be symmetric.
Verrall shows that elements of the transformation matrix are as follows :

$$T_{jm} = - S_j * S_m \qquad \text{if } m \neq j$$

$$= S_j * (1 - S_j) \qquad \text{if } m = j$$

The various matrices for the example data are shown in Table E2.

The table also shows the pattern standard errors and their coefficients of variation.

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E5.12 It is worth noting that as the patterns (S_j 's) for the Employers Liability risk group are similar from company to company and differ more by development period these transformation matrices are very similar from company to company for this particular risk group.

E5.13 Now it is clear from the definition of the variance-covariance matrix of the coefficients

$$\sigma^2 (X'X)^{-1}$$

that the only difference between these matrices for any one model is a scalar difference determined by the particular σ^2 of the data set being fitted. That is the matrix part $(X'X)^{-1}$ is the same for all data sets given the same model as the design matrix X is not affected by the data values.

E5.14 These observations have a significant consequence which results in the identification of the regression standard error sigma (σ) as the single parameter measure of pattern variability for each company for this particular risk group.

E6 Models used in the tables

E6.1 In view of the unfamiliarity of these techniques, and time constraints, we have restricted the models from which results are presented here to the equivalent of the chain ladder with and without inflation adjustment. In both cases it was assumed, for consistency, that no payments are outstanding beyond the given payment triangle as no information except the company estimate of outstanding was available.

E6.2 We have only used incremental paids from 1981 to 1987 to fit our models. The regression approach does not need cumulative payments and works happily with just such data.

E6.3 In the case of the inflation adjusted method the derived patterns are in constant price terms. No attempt was made to re-inflate these patterns as has been done for the main tables in this report.

E6.4 Other models were tried, including a test for superimposed inflation which these methods facilitate very easily, but no results are shown in what is an exploratory section.

E7 Description of tables

E7.1 We show first (Table E1) the regression example for the fire data. This has the base incremental paids, the design matrix and the regression output from the spreadsheet. We follow this by writing down the matrices needed to derive the pattern standard error and show this result (Table E2).

E7.2 The patterns, their standard errors, coefficients of variation and the ratio of the coefficients of variation to the regression standard error are then tabulated for the Employers Liability risk group for the stochastic BCL and IACL models. These results are shown in Tables E3 to E6.

E7.3 We finally have two charts. Chart E1 shows the residual analysis plot for the IACL model against development year for the aggregate Employers Liability data. This is given to illustrate the heteroscedasticity phenomenon mentioned in the text. Chart E2 shows the relationship between the logarithm of the size of the risk group and the run-off variability as measured by the regression standard error.

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E8 Closing remarks

E8.1 Results on patterns derived using the stochastic models are very close to those obtained from the traditional methods.

E8.2 A significant proportion of the inter-company pattern differences at a given duration period are explained by the stochastic variation in the data.

E8.3 As was to be expected from earlier remarks the pattern standard errors for any one development period and model differ (approximately) by a factor in direct proportion to the standard error of the regression for the particular data set. We see this most clearly by tabulating the ratio of pattern coefficients of variation and regression standard error. Please see tables.

E8.4 For the Employers Liability risk group the standard errors for the IACL are slightly higher than those of the BCL method. The inclusion of the index appears to have added to the noise element in our data. The reasons for this have not been explored but clearly this is another area where the regression approach has produced interesting, if not fully understood at present, results.

E8.5 Perhaps more interestingly there appears to be a linear looking relationship between the logarithm of the size of the risk group and the regression standard error. That is larger companies exhibit less pattern variability than smaller ones, as was to be expected, with a log-linear relation to size. Whether we can generalise this kind of result to other risk groups remains open at the moment. It is this kind of result however that best illustrates the benefits gained by the stochastic approach.

The attached Chart E2 shows this relationship.

E8.6 The above observation leads us to view the regression standard error as a good candidate for a single value figure that measures run-off pattern variability by company.

E8.7 It is possible that these models, and particularly the analysis of residuals, may facilitate and formalise the search for trends and changes in these patterns. This is an area where more work and time are needed.

E8.8 The stochastic approach also enables us to derive reserve estimates and their associated standard errors which the traditional chain ladder does not. See Renshaw and Verrall for more details. The CWP data could be used to explore these methods further.

E9 References

E Kremer (1982) ....IBNR-Claims and the Two-way Model of ANOVA
                        Scand. Actuarial J. 1982   Vol 1

Claims Reserving Manual (1989) .... Institute of Actuaries

A Renshaw and R Verrall (1989) .... City University

    Claims Reserving -
            Statistical Treatment of the Chain-Ladder Technique

R Verrall (to appear)..... Chain Ladder and Maximum Likelihood

Regression example using Fire data   TABLE E1

Part a: Incremental Paid

Development period

Acc Yr	0	1	2	3	4	5	6
0	26630	25016	3330	1388	662	414	82
1	42825	22475	3573	1512	860	356	
2	39616	24787	5742	2034	1249		
3	53874	28205	6737	3178			
4	57060	39855	5847				
5	75909	45658					
6	105212						

Part b: Regression table   < ---------------- Design Matrix X ---------------- >

Acc Yr	Dev Yr	Pij	Yij = Ln Pij	A0	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
0	0	26630	10.1898	1	0	0	0	0	0	0	0	0	0	0	0	0
0	1	25016	10.1273	1	0	0	0	0	0	0	1	0	0	0	0	0
0	2	3330	8.1107	1	0	0	0	0	0	0	0	1	0	0	0	0
0	3	1388	7.2356	1	0	0	0	0	0	0	0	0	1	0	0	0
0	4	662	6.4953	1	0	0	0	0	0	0	0	0	0	1	0	0
0	5	414	6.0259	1	0	0	0	0	0	0	0	0	0	0	1	0
0	6	82	4.4067	1	0	0	0	0	0	0	0	0	0	0	0	1
1	0	42825	10.6649	0	1	0	0	0	0	0	0	0	0	0	0	0
1	1	22475	10.0202	0	1	0	0	0	0	0	1	0	0	0	0	0
1	2	3573	8.1812	0	1	0	0	0	0	0	0	1	0	0	0	0
1	3	1512	7.3212	0	1	0	0	0	0	0	0	0	1	0	0	0
1	4	860	6.7569	0	1	0	0	0	0	0	0	0	0	1	0	0
1	5	356	5.8749	0	1	0	0	0	0	0	0	0	0	0	1	0
2	0	39616	10.5870	0	0	1	0	0	0	0	0	0	0	0	0	0
2	1	24787	10.1181	0	0	1	0	0	0	0	1	0	0	0	0	0
2	2	5742	8.6556	0	0	1	0	0	0	0	0	1	0	0	0	0
2	3	2034	7.6178	0	0	1	0	0	0	0	0	0	1	0	0	0
2	4	1249	7.1301	0	0	1	0	0	0	0	0	0	0	1	0	0
3	0	53874	10.8944	0	0	0	1	0	0	0	0	0	0	0	0	0
3	1	28205	10.1737	0	0	0	1	0	0	0	1	0	0	0	0	0
3	2	6737	8.8154	0	0	0	1	0	0	0	0	1	0	0	0	0
3	3	3178	8.0640	0	0	0	1	0	0	0	0	0	1	0	0	0
4	0	57060	10.9519	0	0	0	0	1	0	0	0	0	0	0	0	0
4	1	39855	10.5930	0	0	0	0	1	0	0	1	0	0	0	0	0
4	2	5847	8.6737	0	0	0	0	1	0	0	0	1	0	0	0	0
5	0	75909	11.2373	0	0	0	0	0	1	0	0	0	0	0	0	0
5	1	45658	10.7289	0	0	0	0	0	1	0	1	0	0	0	0	0
6	0	105212	11.5637	0	0	0	0	0	0	1	0	0	0	0	0	0

Part c: Regression Output:

Constant	0
Std Err of Y Est	.1661762 <------- This is the regression standard error (sigma)
R Squared(Adj,Raw)	.9925650 .9958694
No. of Observations	28
Degrees of Freedom	15

	A0	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
Coefficient(s)	10.329	10.435	10.693	10.903	10.951	11.213	11.564	-.4607	-2.175	-3.030	-3.692	-4.431	-5.922
Std Err of Coef.	.0965	.0965	.0989	.1034	.1115	.1269	.1662	.0959	.1029	.1115	.1237	.1443	.1922

Calculation of pattern standard errors

Part 1: Var-Cov matrix of coefficients (divided by sigma squared) ie (I´I)¯-1

A0	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
.3375000	.1708333	.1541667	.1375000	.1166667	.0833333	0	-.166667	-.183333	-.200000	-.220833	-.254167	-.337500
.1708333	.3375000	.1541667	.1375000	.1166667	.0833333	0	-.166667	-.183333	-.2	-.220833	-.254167	-.170833
.1541667	.1541667	.3541667	.1375000	.1166667	.0833333	0	-.166667	-.183333	-.200000	-.220833	-.154167	-.154167
.1375000	.1375000	.1375000	.3875000	.1166667	.0833333	0	-.166667	-.183333	-.2	-.137500	-.1375	-.137500
.1166667	.1166667	.1166667	.1166667	.4500000	.0833333	0	-.166667	-.183333	-.116667	-.116667	-.116667	-.116667
.0833333	.0833333	.0833333	.0833333	.0833333	.5833333	0	-.166667	-.083333	-.083333	-.083333	-.083333	-.083333
0	0	0	0	0	0	1	0	0	0	0	0	0
-.166667	-.166667	-.166667	-.166667	-.166667	-.166667	0	.3333333	.1666667	.1666667	.1666667	.1666667	.1666667
-.183333	-.183333	-.183333	-.183333	-.183333	-.083333	0	.1666667	.3833333	.1833333	.1833333	.1833333	.1833333
-.200000	-.2	-.200000	-.2	-.116667	-.083333	0	.1666667	.1833333	.4500000	.2	.2000000	.2000000
-.220833	-.220833	-.220833	-.137500	-.116667	-.083333	0	.1666667	.1833333	.2	.5541667	.2208333	.2208333
-.254167	-.254167	-.154167	-.1375	-.116667	-.083333	0	.1666667	.1833333	.2000000	.2208333	.7541667	.2541667
-.337500	-.170833	-.154167	-.137500	-.116667	-.083333	0	.1666667	.1833333	.2000000	.2208333	.2541667	1.3375

Part 2: Var-Cov matrix of development coefficients including B0 (divided by sigma squared)

B0	B1	B2	B3	B4	B5	B6
0	0	0	0	0	0	0
0	.3333333	.1666667	.1666667	.1666667	.1666667	.1666667
0	.1666667	.3833333	.1833333	.1833333	.1833333	.1833333
0	.1666667	.1833333	.4500000	.2	.2000000	.2000000
0	.1666667	.1833333	.2	.5541667	.2208333	.2208333
0	.1666667	.1833333	.2000000	.2208333	.7541667	.2541667
0	.1666667	.1833333	.2000000	.2208333	.2541667	1.3375

Part 3: Transformation matrix T (partial derivatives) see text for formula

.2479048	-.187912	-.033839	-.014385	-.007427	-.003544	-.000798
-.187912	.2257589	-.021347	-.009075	-.004685	-.002236	-.000503
-.033839	-.021347	.0581570	-.001634	-.000844	-.000403	-.000091
-.014385	-.009075	-.001634	.0256630	-.000359	-.000171	-.000039
-.007427	-.004685	-.000844	-.000359	.0134229	-.000088	-.000020
-.003544	-.002236	-.000403	-.000171	-.000088	.0064511	-.000009
-.000798	-.000503	-.000091	-.000039	-.000020	-.000009	.0014601

(remember this is derived from the pattern which is)
.5457732 .3443044 .0620011 .0263578 .0136081 .0064932 .0014622

Part 4: Var-Cov matrix V(S) of pattern (divided by sigma squared)

							Diagonal	se pattern	Coef of Variation
.0165090	-.014594	-.001168	-.000424	-.000207	-.000095	-.000020	.0165090	.0213515	3.912158
-.014594	.0145313	-.000020	.0000370	.0000266	.0000150	.0000042	.0145313	.0200318	5.818064
-.001168	-.000020	.0009952	.0001044	.0000553	.0000268	.0000062	.0009952	.0052423	8.455144
-.000424	.0000370	.0001044	.0002331	.0000313	.0000151	.0000035	.0002331	.0025373	9.626384
-.000207	.0000266	.0000553	.0000313	.0000820	.0000098	.0000022	.0000820	.0015050	11.05976
-.000095	.0000150	.0000268	.0000151	.0000098	.0000272	.0000014	.0000272	.0008666	13.34590
-.000020	.0000042	.0000062	.0000035	.0000022	.0000014	.0000026	.0000026	.0002697	18.44223

Please note we calculate the pattern standard error by multiplying the square root of the diagonal element by the regression standard error which was 0.1661762 in this example.

Part 5: Results summary

pattern	:	.5458	.3443	.0620	.0264	.0136	.0065	.0015
standard error	:	.0214	.0200	.0052	.0025	.0015	.0009	.0003
Coef variation %	:	3.91	5.82	8.46	9.63	11.06	13.35	18.44

Class : EMPLOYERS' LIABILITY   Method : STOCHASTIC CHAIN LADDER

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11	12
Avon	2729	26	197	245	175	119	88	84	25	9	8	7	7	11
Commercial Union	96849	30	181	227	207	164	99	46	22	12	8	2	2	1
Co-operative	12939	36	165	182	167	156	125	85	37	24	6	7	6	4
Cornhill	14576	26	183	250	218	119	85	47	23	40	3	2	1	2
Eagle Star	313673	25	177	213	183	132	90	56	40	22	19	11	10	21
General Accident	88894	26	168	225	191	149	86	58	30	20	12	19	5	10
Guardian Royal	134024	40	202	212	174	133	96	58	38	26	10	6	5	1
Iron Trades Mutual	21669	24	165	221	188	130	104	67	39	39	15	3	1	2
Iron Trades Employers	217328	40	214	212	167	128	79	58	40	29	15	11	3	3
Legal & General	18212	26	173	255	205	153	75	63	32	7	5	2	5	1
National Employers Mutual	44051	24	156	208	175	126	97	77	49	28	7	11	6	36
Norwich Union	28209	21	146	227	217	156	101	47	33	25	8	12	1	7
Orion	5316	16	135	260	218	149	64	81	40	17	4	5	5	6
Pearl	5116	27	116	282	237	167	75	29	20	22	7	6	4	9
Provincial	12075	21	170	261	205	126	102	53	15	16	15	4	4	7
Prudential	21557	55	176	231	201	152	80	43	34	16	4	2	2	3
Royal	44870	40	213	211	174	125	97	59	31	19	18	6	4	3
Sun Alliance	83832	16	116	167	182	167	116	89	52	38	20	11	12	12
Total	1166036	30	179	214	183	138	92	60	39	25	15	10	6	9

PATTERN STANDARD ERRORS

Name	Sigma	0	1	2	3	4	5	6	7	8	9	10	11	12
Avon	.794820	10	58	63	49	36	28	28	10	4	4	4	5	10
Commercial Union	.458158	6	31	35	32	27	18	9	5	3	2	1	1	0
Co-operative	.562048	10	36	36	33	31	27	20	10	7	2	3	3	2
Cornhill	.542246	7	37	44	39	25	19	11	6	12	1	1	1	1
Eagle Star	.137108	2	9	10	9	7	5	3	3	2	2	1	1	3
General Accident	.382238	5	25	29	25	21	13	10	6	4	3	5	2	4
Guardian Royal	.359429	7	26	26	22	18	14	9	7	5	2	1	2	0
Iron Trades Mutual	.469777	5	30	35	30	22	19	13	9	10	4	1	1	1
Iron Trades Employers	.276541	5	21	20	16	13	9	7	5	4	2	2	1	1
Legal & General	.671110	8	44	55	46	37	21	18	10	3	2	1	3	1
National Employers Mutual	.524881	6	32	38	32	24	20	17	12	8	2	4	2	21
Norwich Union	.547525	5	31	42	39	31	22	11	9	7	3	4	1	4
Orion	1.05009	8	56	88	76	57	28	36	20	10	3	4	4	7
Pearl	.854150	11	40	75	66	51	26	11	8	10	4	3	3	8
Provincial	.775465	8	50	65	53	37	32	18	6	7	7	2	3	6
Prudential	.665625	17	44	50	45	37	22	13	11	6	2	1	1	2
Royal	.385978	7	30	28	23	18	15	10	6	4	4	2	1	1
Sun Alliance	.307348	2	15	19	19	18	13	11	7	6	3	2	3	4
Total	.109432	2	7	8	7	5	4	3	2	1	1	1	1	1

Class : EMPLOYERS' LIABILITY   Method : STOCHASTIC CHAIN LADDER

PATTERN COEFFICIENTS OF VARIATION (PERCENTAGES)

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11	12
Avon	2729	38	29	26	28	30	32	34	39	43	49	56	67	90
Commercial Union	96849	22	17	15	15	16	18	20	23	25	28	32	39	53
Co-operative	12939	27	22	20	20	20	21	23	27	30	34	39	47	64
Cornhill	14576	26	20	18	18	21	22	24	27	29	34	38	46	62
Eagle Star	313673	7	5	5	5	5	5	6	6	7	8	9	11	15
General Accident	88894	18	15	13	13	14	15	16	18	20	23	26	32	43
Guardian Royal	134024	17	13	12	12	13	14	16	17	19	22	25	30	41
Iron Trades Mutual	21669	22	18	16	16	17	18	20	22	25	28	33	39	54
Iron Trades Employers	217328	13	10	9	10	10	11	12	13	15	17	19	23	32
Legal & General	18212	32	25	22	23	25	28	29	33	37	42	48	57	77
National Employers Mutual	44051	25	21	18	18	19	20	22	24	27	31	36	43	58
Norwich Union	28209	26	21	18	18	20	22	24	26	29	33	38	46	62
Orion	5316	51	42	34	35	38	43	45	51	57	64	73	88	120
Pearl	5116	41	35	27	28	31	35	38	42	47	53	60	72	97
Provincial	12075	37	29	25	26	29	31	34	38	42	47	55	65	88
Prudential	21557	30	25	22	22	24	27	30	33	37	41	47	56	76
Royal	44870	18	14	13	13	14	15	17	19	21	23	27	32	44
Sun Alliance	83832	15	13	11	11	11	11	12	14	16	18	21	25	34
Total	1166036	5	4	4	4	4	4	5	5	6	7	8	9	12

COEFFICIENTS OF VARIATION % / S E REGRESSION (sigma)

Name	Sigma	0	1	2	3	4	5	6	7	8	9	10	11	12
Avon	.794820	47	37	32	35	38	40	43	49	55	61	70	84	113
Commercial Union	.458158	47	37	33	33	36	40	44	49	55	62	71	85	115
Co-operative	.562048	47	38	35	35	35	38	41	47	53	60	69	83	114
Cornhill	.542246	47	37	32	33	38	41	44	49	54	62	71	85	115
Eagle Star	.137108	48	38	34	34	37	39	43	47	53	60	69	83	112
General Accident	.382238	47	38	33	34	36	40	43	48	54	60	69	83	113
Guardian Royal	.359429	47	36	34	35	37	40	43	48	54	61	70	84	114
Iron Trades Mutual	.469777	48	38	34	34	37	39	42	48	53	60	70	84	114
Iron Trades Employers	.276541	46	36	34	35	37	40	43	48	54	61	70	84	114
Legal & General	.671110	47	38	32	34	37	41	44	49	55	62	71	84	115
National Employers Mutual	.524881	48	39	35	35	37	39	41	46	52	60	68	82	110
Norwich Union	.547525	48	39	33	33	36	39	43	48	54	61	69	84	114
Orion	1.05009	48	40	32	33	36	41	43	48	54	61	70	84	114
Pearl	.854150	48	40	31	33	36	41	45	50	55	62	71	84	114
Provincial	.775465	47	38	32	34	38	40	44	50	55	61	70	84	114
Prudential	.665625	46	37	33	34	36	41	45	49	55	62	71	85	115
Royal	.385978	46	36	34	35	37	40	43	49	54	61	70	84	114
Sun Alliance	.307348	49	41	37	34	35	37	40	45	51	58	67	81	112
Total	.109432	47	38	34	34	36	40	43	48	53	60	69	83	113

Class : EMPLOYERS LIABILITY   Method : STOCHASTIC INFLATION ADJUSTED CHAIN LADDER

RUN-OFF PATTERN PER MILLE
AT CONSTANT PRICES

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11	12
Avon	2729	32	229	264	176	111	73	70	18	5	5	4	4	7
Commercial Union	96849	37	209	243	206	151	85	37	16	8	5	1	1	0
Co-operative	12939	46	196	200	171	148	110	70	28	17	3	4	4	2
Cornhill	14576	33	212	268	217	110	73	38	17	27	2	1	1	1
Eagle Star	313673	32	211	236	188	126	80	46	31	15	12	7	6	11
General Accident	88894	33	199	247	195	141	75	47	23	14	8	12	3	5
Guardian Royal	134024	50	235	229	174	124	83	46	28	18	6	3	3	0
Iron Trades Mutual	21669	31	196	243	191	123	91	54	29	28	10	2	1	1
Iron Trades Employers	217328	51	249	230	168	119	68	46	30	20	10	7	2	2
Legal & General	18212	32	200	273	204	141	64	50	23	5	3	1	3	0
National Employers Mutual	44051	31	189	233	182	122	87	64	37	20	4	7	3	20
Norwich Union	28209	27	173	248	220	147	89	38	24	17	5	7	1	3
Orion	5316	21	159	284	221	141	54	67	31	12	3	3	3	3
Pearl	5116	35	135	304	238	155	65	24	14	15	4	3	2	5
Provincial	12075	27	198	282	204	117	89	43	11	11	10	2	2	4
Prudential	21557	69	202	246	199	140	68	34	25	11	3	1	1	1
Royal	44870	50	248	228	174	116	83	47	23	13	11	4	2	2
Sun Alliance	83832	21	144	192	193	165	107	76	41	28	13	7	7	6
Total	1166036	39	211	235	186	130	80	49	29	18	10	6	3	5

PATTERN STANDARD ERRORS

Name	Sigma	0	1	2	3	4	5	6	7	8	9	10	11	12
Avon	.826968	12	66	69	51	36	25	26	8	3	3	3	3	6
Commercial Union	.458552	8	34	36	32	26	16	8	4	2	1	0	0	0
Co-operative	.574739	12	41	39	34	31	25	17	8	5	1	2	2	1
Cornhill	.543254	8	41	46	39	23	17	9	5	8	1	0	0	1
Eagle Star	.135652	2	11	11	9	7	5	3	2	1	1	1	1	2
General Accident	.384709	6	28	31	26	20	12	8	4	3	2	3	1	2
Guardian Royal	.361162	8	29	27	22	17	12	8	5	4	1	1	1	0
Iron Trades Mutual	.478752	7	34	38	31	22	18	11	7	7	3	1	0	1
Iron Trades Employers	.278182	6	24	21	17	13	8	6	4	3	2	1	0	1
Legal & General	.678133	10	49	58	47	36	18	15	8	2	1	1	2	0
National Employers Mutual	.547740	8	38	42	34	25	19	15	10	6	1	3	2	13
Norwich Union	.549435	7	36	44	40	30	20	10	7	5	2	3	0	2
Orion	1.08002	11	66	95	79	57	24	32	16	7	2	2	3	4
Pearl	.878614	14	47	80	68	51	24	10	6	7	2	2	2	5
Provincial	.808896	10	58	70	56	36	30	16	4	5	5	1	2	4
Prudential	.668057	20	48	53	45	35	19	11	9	4	1	1	1	1
Royal	.385770	9	33	29	24	17	13	8	4	3	3	1	1	1
Sun Alliance	.308290	3	17	21	20	18	13	10	6	5	2	2	2	2
Total	.111182	2	9	9	7	6	4	3	2	1	1	1	0	1

Class : EMPLOYERS' LIABILITY   Method : STOCHASTIC INFLATION ADJUSTED CHAIN LADDER

PATTERN COEFFICIENTS OF VARIATION (PERCENTAGES)

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11	12
Avon	2729	38	29	26	29	32	35	37	42	48	53	61	72	97
Commercial Union	96849	21	16	15	16	17	19	21	23	26	29	34	40	55
Co-operative	12939	26	21	20	20	21	23	25	28	32	36	41	49	68
Cornhill	14576	25	19	17	18	21	23	25	28	30	35	40	48	65
Eagle Star	313673	6	5	5	5	5	6	6	7	8	9	10	12	17
General Accident	88894	18	14	12	13	14	16	17	19	21	24	28	33	46
Guardian Royal	134024	16	13	12	13	14	15	16	18	20	23	26	32	44
Iron Trades Mutual	21669	22	18	16	16	18	19	21	24	26	30	35	42	57
Iron Trades Employers	217328	13	10	9	10	11	12	13	14	16	18	20	25	34
Legal & General	18212	31	25	21	23	26	29	31	35	39	43	50	59	82
National Employers Mutual	44051	25	20	18	19	20	22	24	26	30	34	39	47	64
Norwich Union	28209	26	21	18	18	20	23	25	28	31	35	40	48	66
Orion	5316	51	41	33	36	40	46	48	54	60	69	79	94	128
Pearl	5116	41	34	26	29	33	37	41	45	50	56	64	77	103
Provincial	12075	37	29	25	27	31	33	37	41	46	51	59	70	96
Prudential	21557	30	24	21	23	25	28	31	34	38	43	49	59	80
Royal	44870	17	13	13	14	15	16	18	20	22	24	28	34	46
Sun Alliance	83832	15	12	11	10	11	12	13	15	16	19	22	26	36
Total	1166036	5	4	4	4	4	5	5	6	7	7	8	10	14

COEFFICIENTS OF VARIATION % / S % REGRESSION (sigma)

Name	Sigma	0	1	2	3	4	5	6	7	8	9	10	11	12
Avon	.826968	46	35	31	35	39	42	44	51	57	64	73	87	118
Commercial Union	.458552	46	36	33	34	37	42	46	51	57	64	73	88	121
Co-operative	.574739	46	36	34	35	36	39	43	49	55	63	72	86	119
Cornhill	.543254	46	36	31	33	39	42	46	51	56	64	74	88	119
Eagle Star	.135652	48	37	34	35	39	42	46	51	57	64	74	89	122
General Accident	.384709	46	36	32	34	37	41	45	50	56	63	72	87	119
Guardian Royal	.361162	45	35	33	35	38	42	45	51	56	64	73	87	121
Iron Trades Mutual	.478752	46	37	32	34	38	41	44	50	55	63	73	88	119
Iron Trades Employers	.278182	46	34	33	36	39	43	46	51	57	64	73	88	122
Legal & General	.678133	46	36	31	34	38	42	46	51	57	64	73	88	120
National Employers Mutual	.547740	46	37	33	34	37	40	43	48	54	62	71	85	116
Norwich Union	.549435	47	38	33	33	37	41	45	50	56	63	72	87	120
Orion	1.08002	47	38	31	33	37	42	44	50	56	64	73	87	118
Pearl	.878614	46	39	30	33	37	42	46	51	57	64	73	88	118
Provincial	.808896	46	36	31	34	38	41	45	51	57	63	72	87	119
Prudential	.668057	44	36	32	34	38	42	46	51	57	64	73	88	120
Royal	.385770	45	34	33	35	39	42	46	51	57	64	73	88	121
Sun Alliance	.308290	48	39	35	34	35	39	42	47	53	61	70	85	118
Total	.111182	48	38	35	36	40	43	47	53	59	66	76	91	126

CHART 1
RESIDUAL ANALYSIS : TOTAL EMPLOYERS LIABILITY
BASED ON INFLATION ADJUSTED REGRESSION MODEL

STANDARDISED RESIDUAL

DEVELOPMENT PERIOD IN YEARS

NOTE SOME EVIDENCE OF HETEROSCEDASTICITY BUT NOT CRITICAL

Ln Size Vs Regression Standard Error   CHART 2
Employers Liability Risk Group
Stochastic Inflation Adjusted Chain Ladder Model

Regression Standard Error (Sigma)

Ln Size of Risk Group

Linear equation :   s e   = 2.237 - 0.163 * ln Size   : fit r^2 = 0.81
Logs rule OK   S.C. 219.89

REPORT OF THE

WORKING PARTY

ON

CLAIMS RUN-OFF PATTERNS

presented to

General Insurance Study Group

October 1989

Remaining Tables etc

Section C: Tables 23
                    24
                    31
                    32
                    36 (corrected)
                    40
                    46
                    49)
                    50) completed, with 3 corrections

Section D: Graphs 11)
                    12) completed

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	31691	631	235	37	38	23	22	7	2	2	3	0	0
Britannic	11180	624	230	35	34	35	10	11	1	1	4	11	3
Commercial Union	264077	650	227	36	31	31	13	7	4	1	1	0	0
Co-operative	239737	614	219	39	38	29	20	15	9	6	2	2	8
Cornhill	206572	617	238	40	37	25	18	9	5	5	3	1	3
Eagle Star *	326819	620	232	42	35	27	15	11	8	6	4	0	1
General Accident	594874	625	239	36	33	20	15	11	7	5	2	2	5
Guardian Royal	515861	636	239	44	36	19	13	6	3	2	1	0	0
Iron Trades Mutual *	183011	612	249	43	36	25	19	8	4	4	1	0	0
Legal & General	73122	586	257	40	35	26	22	13	10	4	1	3	2
London & Edinburgh	76420	590	256	42	47	17	19	16	8	2	0	1	0
National Employers Mutual	83565	619	230	38	37	25	15	11	13	11	1	1	0
National Farmers Union Mutual	118677	591	225	38	47	36	19	18	10	9	6	0	0
National Insurance & Guarantee	138462	615	253	41	32	28	15	7	6	1	0	0	1
Norman *	20622	605	237	40	49	24	24	6	4	10	0	0	0
Norwich Union *	306017	583	280	41	38	28	13	9	7	2	0	0	0
Pearl	42718	580	242	61	51	28	27	8	3	0	1	0	0
Provincial	158504	611	238	42	39	24	16	13	6	6	1	3	0
Prudential	250410	620	239	39	31	27	16	10	6	3	4	1	5
Royal *	361770	619	230	44	38	29	17	13	4	4	1	0	1
Sun Alliance & London	550728	618	248	42	36	22	16	9	4	2	1	1	1
Wesleyan & General	6389	590	212	33	35	60	48	8	13	0	0	0	0
Total	4561226	620	240	40	35	25	16	10	6	4	2	1	2

* For these companies separate Comp data were available.

MEAN TERM

Name	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	1.23	1.48	2.18	1.82	1.65	1.36	1.64	1.60	1.08	.50	.00	.00
Britannic	1.36	1.79	2.83	2.57	2.47	3.13	3.00	3.31	2.51	1.64	.97	2.00
Commercial Union	1.16	1.39	2.05	1.70	1.35	1.36	1.24	1.23	1.61	1.49	1.65	2.00
Co-operative	1.46	2.00	2.96	2.70	2.62	2.60	2.61	2.79	2.88	3.15	2.58	2.00
Cornhill	1.32	1.64	2.50	2.26	2.21	2.21	2.39	2.37	2.12	2.19	2.30	2.00
Eagle Star *	1.31	1.63	2.42	2.19	2.03	1.95	1.69	1.40	1.12	.99	2.47	2.00
General Accident	1.31	1.67	2.73	2.54	2.57	2.49	2.43	2.48	2.49	2.66	2.13	2.00
Guardian Royal	1.16	1.32	1.90	1.66	1.59	1.42	1.36	1.25	.92	.89	2.75	2.00
Iron Trades Mutual *	1.25	1.43	2.10	1.83	1.61	1.38	1.39	1.15	.74	.75	.16	2.00
Legal & General	1.40	1.68	2.62	2.34	2.13	1.90	1.84	1.73	2.07	2.07	1.53	2.00
London & Edinburgh	1.33	1.53	2.25	1.91	1.95	1.50	1.21	1.19	1.66	2.05	1.29	2.00
National Employers Mutual	1.35	1.72	2.59	2.28	2.16	1.98	1.61	1.08	.69	1.01	.69	2.00
National Farmers Union Mutual	1.49	1.93	2.67	2.24	2.08	1.97	1.59	1.35	.92	.51	.25	2.00
National Insurance & Guarantee	1.22	1.38	2.08	1.80	1.50	1.43	1.37	1.18	1.85	3.30	3.00	2.00
Norman *	1.32	1.59	2.23	1.83	1.78	1.48	1.66	1.21	.50	.00	.00	.00
Norwich Union *	1.27	1.34	2.06	1.72	1.51	1.42	1.12	.77	.81	3.17	1.87	2.00
Pearl	1.34	1.50	1.85	1.55	1.37	.99	1.11	1.18	1.83	1.16	.90	2.00
Provincial	1.33	1.64	2.43	2.17	2.10	1.93	1.72	1.70	1.39	1.53	.82	2.00
Prudential	1.32	1.66	2.64	2.46	2.31	2.44	2.52	2.69	2.72	2.29	2.55	2.00
Royal *	1.30	1.59	2.24	1.95	1.76	1.66	1.48	1.74	1.65	2.34	2.46	2.00
Sun Alliance & London	1.24	1.43	2.15	1.90	1.82	1.67	1.67	1.84	1.90	2.06	1.62	2.00
Wesleyan & General	1.50	1.95	2.51	1.91	1.30	.99	1.12	.51	.50	.00	.00	.00
Total	1.29	1.57	2.41	2.18	2.08	2.04	2.04	2.11	2.17	2.37	2.16	2.00

* For these companies separate Comp data were available.

Risk group : MOTOR - NON COMPREHENSIVE   Method : AVERAGE CLAIM

RUN-OFF PATTERN PER MILLE

Name	Size	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	9107	356	230	117	126	58	68	21	8	7	10	0	0
Britannic	2832	238	214	103	178	98	42	44	6	5	17	46	11
Commercial Union	20396	301	250	154	114	94	44	25	12	3	2	1	1
Co-operative	43687	247	230	126	112	94	62	46	27	20	5	5	26
Cornhill	22891	290	248	133	103	91	55	27	15	15	9	4	10
Eagle Star *	36853	247	224	139	128	79	68	43	24	8	9	5	25
General Accident	78319	269	232	118	107	100	56	42	26	19	6	9	17
Guardian Royal	89878	259	277	155	121	92	49	25	11	9	3	0	0
Iron Trades Mutual *	27671	355	231	91	110	97	63	17	22	9	1	0	4
Legal & General	5869	244	228	118	155	60	78	47	37	13	5	9	7
London & Edinburgh	50816	320	262	113	106	71	53	43	21	5	1	3	1
National Employers Mutual	6403	312	255	142	98	63	39	27	33	28	2	2	0
National Farmers Union Mutual	17580	257	214	106	158	83	54	53	30	27	19	1	0
National Insurance & Guarantee	44045	312	278	124	109	81	49	23	18	5	1	0	2
Norman *	769	351	329	57	84	38	9	25	106	0	0	0	0
Norwich Union *	76576	297	236	126	115	89	66	29	15	13	7	7	-1
Pearl	5869	210	218	207	119	128	82	23	9	1	2	1	0
Provincial	19609	274	242	143	126	70	52	42	19	18	3	10	1
Prudential	27515	301	250	122	112	74	51	33	18	8	13	3	15
Royal *	26999	254	264	152	117	92	67	28	18	6	2	1	0
Sun Alliance & London	89025	285	259	158	107	81	50	29	13	7	2	4	3
Wesleyan & General	989	298	180	120	104	128	119	19	31	0	0	0	0
Total	703698	285	251	132	114	84	53	33	19	12	5	4	8

* For these companies separate Non-comp data were available.

Risk group : MOTOR – NON COMPREHENSIVE

Method : AVERAGE CLAIM

MEAN TERM

Name	0	1	2	3	4	5	6	7	8	9	10	11+
Avon	2.24	2.20	2.14	1.79	1.73	1.36	1.64	1.60	1.08	.50	.00	.00
Britannic	3.14	2.96	2.92	2.48	2.80	3.13	3.00	3.31	2.51	1.64	.97	2.00
Commercial Union	2.29	2.06	1.92	1.67	1.40	1.36	1.24	1.23	1.61	1.49	1.65	2.00
Co-operative	3.05	2.89	2.94	2.71	2.58	2.60	2.61	2.79	2.88	3.15	2.58	2.00
Cornhill	2.59	2.45	2.49	2.29	2.11	2.21	2.39	2.37	2.12	2.19	2.30	2.00
Eagle Star *	2.98	2.79	2.76	2.57	2.58	2.49	2.68	3.02	3.31	2.87	2.57	2.00
General Accident	2.91	2.80	2.86	2.59	2.40	2.49	2.43	2.48	2.49	2.66	2.13	2.00
Guardian Royal	2.39	2.05	1.97	1.71	1.49	1.42	1.36	1.25	.92	.89	2.75	2.00
Iron Trades Mutual *	2.33	2.34	2.37	1.89	1.61	1.55	1.82	1.44	1.89	3.39	3.00	2.00
Legal & General	2.92	2.70	2.65	2.27	2.34	1.90	1.84	1.73	2.07	2.07	1.53	2.00
London & Edinburgh	2.35	2.22	2.31	1.98	1.78	1.50	1.21	1.19	1.66	2.05	1.29	2.00
National Employers Mutual	2.43	2.31	2.37	2.28	2.17	1.98	1.61	1.08	.69	1.01	.69	2.00
National Farmers Union Mutual	2.91	2.75	2.66	2.20	2.21	1.97	1.59	1.35	.92	.51	-.25	2.00
National Insurance & Guarantee	2.25	2.04	2.09	1.77	1.55	1.43	1.37	1.18	1.85	3.30	3.00	2.00
Norman *	2.29	2.25	3.06	2.62	2.62	2.19	1.31	.50	.00	.00	.00	.00
Norwich Union *	2.53	2.39	2.34	2.02	1.80	1.64	1.72	1.56	1.18	.85	.24	2.00
Pearl	2.65	2.22	1.88	1.66	1.22	.99	1.11	1.18	1.83	1.16	.90	2.00
Provincial	2.62	2.42	2.37	2.16	2.14	1.93	1.72	1.70	1.39	1.53	.82	2.00
Prudential	2.61	2.51	2.64	2.43	2.43	2.44	2.52	2.69	2.72	2.29	2.55	2.00
Royal *	2.49	2.16	2.07	1.80	1.50	1.26	1.20	.93	.82	.64	.02	2.00
Sun Alliance & London	2.40	2.15	2.09	1.94	1.74	1.67	1.67	1.84	1.90	2.06	1.62	2.00
Wesleyan & General	2.67	2.60	2.32	1.87	1.35	.99	1.12	.51	.50	.00	.00	.00
Total	2.57	2.39	2.42	2.18	2.06	2.04	2.04	2.11	2.17	2.37	2.16	2.00

* For these companies separate Non-comp data were available.

ASSUMED MEAN TERM FOR OUTSTANDING : SENSITIVITY ANALYSIS

BASED ON EACH RISK GROUP'S AGGREGATE DATA

Method : INFLATION ADJUSTED CHAIN LADDER

Risk group : MOTOR - COMPREHENSIVE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11+
1	1.27	1.55	2.38	2.15	2.04	1.97	1.94	1.94	1.89	1.89	1.49	1.00
Diff	.00	-.01	-.02	-.03	-.04	-.06	-.10	-.17	-.28	-.47	-.67	-1.00
2	1.27	1.55	2.40	2.18	2.08	2.04	2.04	2.11	2.17	2.37	2.16	2.00
3	1.27	1.56	2.42	2.20	2.12	2.10	2.15	2.29	2.46	2.85	2.83	3.00
Diff	.00	.01	.02	.03	.04	.07	.11	.18	.29	.48	.68	1.00
4	1.28	1.57	2.44	2.23	2.17	2.17	2.26	2.47	2.76	3.34	3.52	4.00
Diff	.01	.02	.04	.06	.08	.13	.22	.36	.59	.98	1.36	2.00

Risk group : MOTOR - NON COMPREHENSIVE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11+
1	2.55	2.37	2.39	2.16	2.02	1.97	1.94	1.94	1.89	1.89	1.49	1.00
Diff	-.01	-.01	-.02	-.03	-.04	-.06	-.10	-.17	-.28	-.47	-.67	-1.00
2	2.56	2.39	2.41	2.18	2.06	2.04	2.04	2.11	2.17	2.37	2.16	2.00
3	2.57	2.40	2.43	2.21	2.10	2.10	2.15	2.29	2.46	2.85	2.83	3.00
Diff	.01	.01	.02	.03	.04	.07	.11	.18	.29	.48	.68	1.00
4	2.58	2.41	2.45	2.24	2.15	2.17	2.26	2.47	2.76	3.34	3.52	4.00
Diff	.02	.03	.04	.06	.08	.13	.22	.36	.59	.98	1.36	2.00

ASSUMED MEAN TERM FOR OUTSTANDING : SENSITIVITY ANALYSIS

BASED ON EACH RISK GROUP'S AGGREGATE DATA

Method : AVERAGE CLAIM METHOD

Risk group : MOTOR - COMPREHENSIVE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11+
1	1.29	1.57	2.39	2.15	2.04	1.97	1.94	1.94	1.89	1.89	1.49	1.00
Diff	.00	-.01	-.02	-.03	-.04	-.06	-.10	-.17	-.28	-.47	-.67	-1.00
2	1.29	1.57	2.41	2.18	2.08	2.04	2.04	2.11	2.17	2.37	2.16	2.00
3	1.29	1.58	2.43	2.20	2.12	2.10	2.15	2.29	2.46	2.85	2.83	3.00
Diff	.00	.01	.02	.03	.04	.07	.11	.18	.29	.48	.68	1.00
4	1.29	1.59	2.45	2.23	2.16	2.17	2.26	2.47	2.76	3.34	3.52	4.00
Diff	.01	.02	.04	.06	.08	.13	.22	.36	.59	.98	1.36	2.00

Risk group : MOTOR - NON COMPREHENSIVE

Assumed Outstanding Mean term	0	1	2	3	4	5	6	7	8	9	10	11+
1	2.56	2.38	2.40	2.16	2.02	1.97	1.94	1.94	1.89	1.89	1.49	1.00
Diff	-.01	-.01	-.02	-.03	-.04	-.06	-.10	-.17	-.28	-.47	-.67	-1.00
2	2.57	2.39	2.42	2.18	2.06	2.04	2.04	2.11	2.17	2.37	2.16	2.00
3	2.58	2.41	2.44	2.21	2.10	2.10	2.15	2.29	2.46	2.85	2.83	3.00
Diff	.01	.01	.02	.03	.04	.07	.11	.18	.29	.48	.68	1.00
4	2.59	2.42	2.46	2.24	2.15	2.17	2.26	2.47	2.76	3.34	3.52	4.00
Diff	.02	.03	.04	.06	.08	.13	.22	.36	.59	.98	1.36	2.00

Method : AVERAGE CLAIM

Risk group : MOTOR - COMPREHENSIVE

Assumed future Inflation rate	0	1	2	3	4	5	6	7	8	9	10	11+
8.00%	620	240	40	35	25	16	10	6	4	2	1	2
7.00%	624	240	40	34	24	15	10	5	3	1	1	2
Diff	4	-1	0	-1	-1	-1	0	0	0	0	0	0
9.00%	615	241	41	36	25	17	11	6	4	2	1	3
Diff	-5	0	0	1	1	1	0	0	0	0	0	0

Risk group : MOTOR - NON COMPREHENSIVE

Assumed future Inflation rate	0	1	2	3	4	5	6	7	8	9	10	11+
8.00%	285	251	132	114	84	53	33	19	12	5	4	8
7.00%	290	253	132	113	82	52	32	18	11	5	4	7
Diff	5	2	0	-1	-2	-1	-1	-1	-1	0	0	-1
9.00%	279	248	132	115	85	55	34	20	13	5	4	8
Diff	-5	-2	0	1	1	1	1	1	1	0	0	1

WEIGHTED MEAN TERMS (USING OUTSTANDING PROPORTIONS ON RUN-OFF PATTERN AS WEIGHTS)

Risk group : MOTOR COMPREHENSIVE

METHOD	IACL	BCL	AVC	CI
Avon	1.62	1.69	1.66	2.12
Britannic	2.25	2.51	2.28	2.37
Commercial Union	1.53	1.86	1.55	1.80
Co-operative	2.42	2.54	2.45	3.05
Cornhill	2.01	2.43	2.01	2.07
Eagle Star	1.82	1.90	1.89	1.93
General Accident	2.13	2.58	2.16	2.18
Guardian Royal	1.48	1.66	1.49	1.77
Iron Trades Mutual	1.65	1.73	1.61	2.30
Legal & General	1.96	2.02	2.00	2.17
London & Edinburgh	1.73	1.78	1.73	1.86
National Employers Mutual	1.98	2.10	1.97	1.90
National Farmers Union Mutual	2.03	2.14	2.07	2.28
National Insurance & Guarantee	1.58	1.60	1.58	1.94
Norman	1.77	1.89	1.74	1.92
Norwich Union	1.53	1.58	1.52	1.75
Pearl	1.54	1.60	1.54	1.97
Provincial	1.89	1.91	1.90	1.93
Prudential	2.11	2.16	2.11	2.20
Royal	1.79	1.88	1.78	2.02
Sun Alliance & London	1.66	1.70	1.68	1.88
Wesleyan & General	1.87	1.93	1.87	2.06
Total	1.89	2.06	1.91	2.11

SENSITIVITY ANALYSIS OF AGGREGATE DATA

WEIGHTED MEAN TERM

BY ASSUMED MEAN TERM FOR TAIL

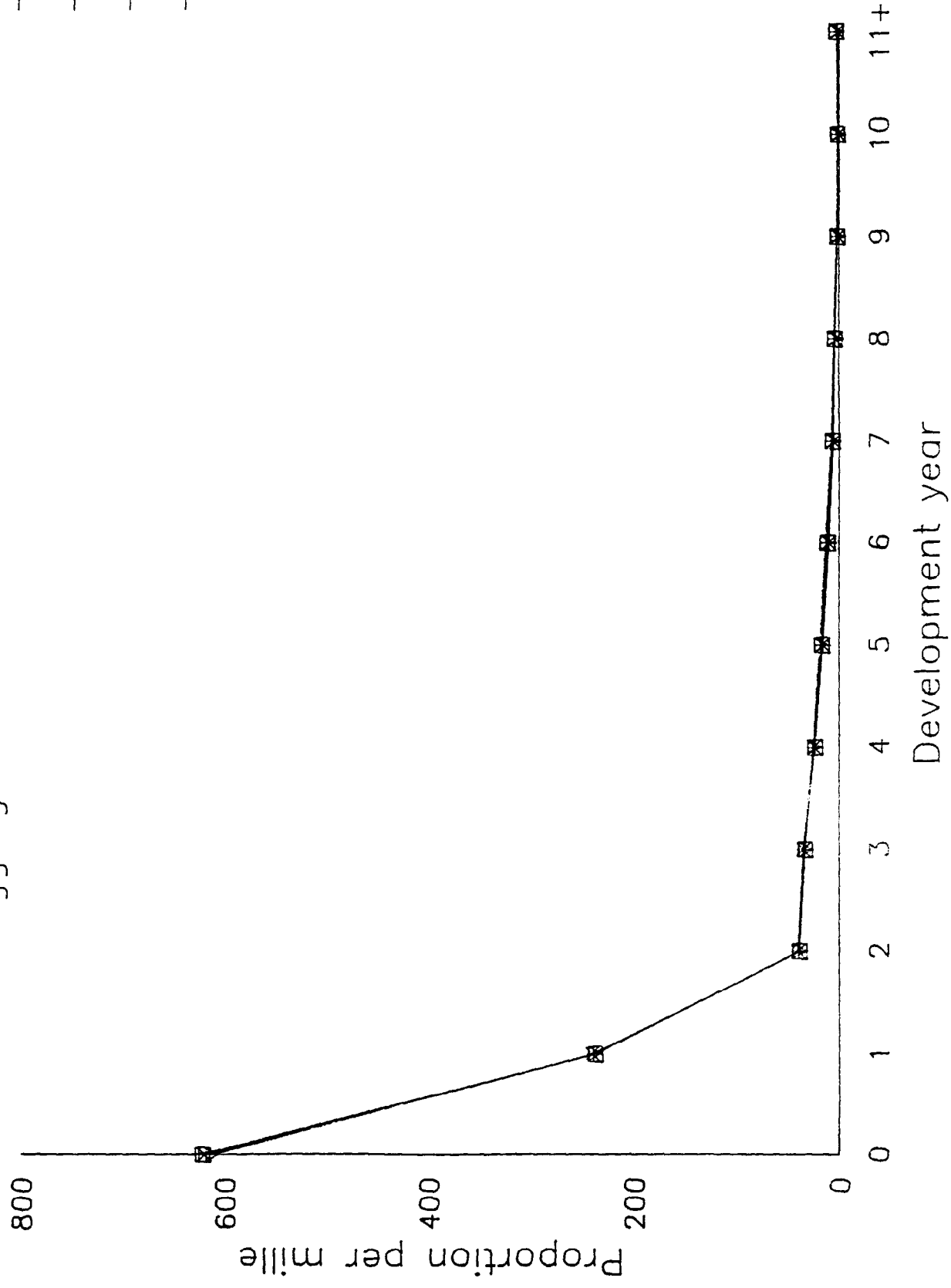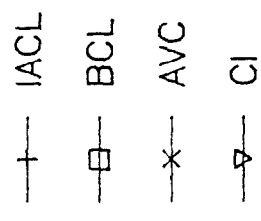| Assumed Mean term for tail	IACL	BCL	AVC	CI
1	1.86	2.02	1.87	2.07
2	1.89	2.06	1.91	2.11
3	1.93	2.11	1.94	2.16
4	1.97	2.16	1.98	2.20

WEIGHTED MEAN TERMS (USING OUTSTANDING PROPORTIONS ON RUN-OFF PATTERN AS WEIGHTS)

Risk group : MOTOR - NON COMPREHENSIVE

METHOD	IACL	BCL	AVC	CI
Avon	1.95	2.04	1.97	2.69
Britannic	2.76	3.04	2.78	3.08
Commercial Union	1.82	2.20	1.83	2.10
Co-operative	2.73	2.91	2.79	3.41
Cornhill	2.31	2.77	2.36	2.16
Eagle Star	2.72	2.80	2.71	2.60
General Accident	2.61	3.11	2.66	2.66
Guardian Royal	1.84	2.04	1.85	2.00
Iron Trades Mutual	2.10	2.17	2.10	2.36
Legal & General	2.42	2.48	2.42	2.35
London & Edinburgh	2.04	2.10	2.04	1.99
National Employers Mutual	2.17	2.28	2.18	2.30
National Farmers Union Mutual	2.33	2.43	2.36	2.43
National Insurance & Guarantee	1.89	1.92	1.90	2.31
Norman	2.29	2.29	2.31	3.39
Norwich Union	2.36	2.44	2.13	2.35
Pearl	1.82	1.87	1.83	2.26
Provincial	2.23	2.26	2.22	2.25
Prudential	2.47	2.57	2.51	2.47
Royal	1.85	1.91	1.90	2.22
Sun Alliance & London	1.99	2.05	2.01	2.16
Wesleyan & General	2.01	2.04	2.04	2.15
Total	2.26	2.46	2.28	2.47

SENSITIVITY ANALYSIS OF AGGREGATE DATA

WEIGHTED MEAN TERM

BY ASSUMED MEAN TERM FOR TAIL

Assumed Mean term for tail	IACL	BCL	AVC	CI
1	2.22	2.40	2.24	2.42
2	2.26	2.46	2.28	2.47
3	2.29	2.52	2.33	2.53
4	2.33	2.58	2.37	2.59

Graph 11. Run-offs -- Comprehensive Motor
Aggregate data -- all four methods

IACL
BCL
AVC
CI

Proportion per mille

Development year

Graph 12. Run-offs — Non-Comp. Motor
Aggregate data — all four methods

Legend:
- IACL
- BCL
- AVC
- CI

Y-axis: Proportion per mille (0, 50, 100, 150, 200, 250, 300)
X-axis: Development year (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11+)