

# 1979 General Insurance Convention

## General Insurance Study Group

### Analysis of Companies DoT Returns

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## Analysis of Companies D.o.T. Returns

### 1. Scope

- 1.1 The U.K. statutory Returns are at present laid down by the Insurance Companies (Accounts and Forms) Regulations 1968.
- 1.2 General Business is covered by the following parts -
  - Schedule 1 - Profit and Loss Account, Balance Sheet, Statement of Assets.
  - Schedule 2 - Part III. Revenue Account (1-year)  
Part IV. Revenue Account (3-year)  
Part V. Premium Analysis
  - Schedule 3 - Part I. Reinsurance Summary  
Part II. Claim Frequency Analysis  
Part III. Claim Settlement Analysis
- 1.3 (a) The number of companies submitting returns runs into several hundreds, of widely varying sizes.
  - (b) The returns of an individual company may in some cases be divided into as many as five separate territories; although this is tending to diminish with the spread of domesticated companies.
  - (c) Within each territory there are six main classes of business, divided into a number of risk-groups; for the larger companies the latter may be in the region of 15 to 20.
  - (d) The present regulations have been in force since 1970 so that up to 8 years' data were available when the research group began its work in 1978.
- 1.4 (a) The research group was obliged to consider how to limit the scope of its activities having regard to the enormous range of possibilities implied by the available data.
  - (b) To this end the following constraints were applied -
    - (i) Companies - only those which had submitted returns during the entire period 1970-1977.
    - (ii) Territory - UK only.
    - (iii) Classes - Liability  
Motor  
Personal Accident  
Property
    - (iv) Risk Groups - Private Car  
Employers Liability  
Personal Accident  
Fire  
  
(these being generally well-defined and representative of the range of claims characteristics).

- 1.5 The scope of the enquiry was further concentrated by focussing attention on the specific aspects discussed in the following paragraph.

## 2. Aspects to be explored

- 2.1 A question of some topicality at the present time is whether there exist any simple tests of a company's performance, as exhibited in the statutory returns, which might provide the supervisory authority with an early-warning of a possible adverse experience. Among the aspects which have been discussed in this connection are -
- (a) Certain key claims ratios.
  - (b) The chain-ladder test.
  - (c) The track-record of past estimating.
- 2.2 To date the discussion of these methods has been hampered by the absence of any systematic investigation into how effectively they work in practice when applied over a wide range of companies over an extended period of time.
- 2.3 The research group therefore decided to examine these aspects with a view to presenting results in a manner which might provide some insight into the effectiveness of the various tests. This aim is a modest one and it is worth discussing briefly why this should be so.
- 2.4 Retrospective examination of various ratios and tests may reveal patterns and variations of interest and possibly of some significance. Being wise after the event we may then be inclined to point to features which ought to have been regarded as significant at the time. Unfortunately the supervisory authority is obliged to be wise before the event!
- 2.5 In contemplating a set of rules for the supervisor it must be recognised that such rules are liable to two types of error -
- (a) An error of the first kind is the failure of the rule to identify an unsound situation in good time.
  - (b) An error of the second kind occurs when the rule incorrectly places a sound company under unwarranted suspicion.
- The supervisor has the unenviable task of steering between this Scylla and Charybdis.
- 2.6 In the main therefore the research group's conclusions are tentative. In some cases the results point to areas for further research.

## 3. Acknowledgements - sources of data

- 3.1 In carrying out its research the group had access to two computerised sources of data -
- (a) The Norwich Union database holds details of the returns of 11 major companies; and has been programmed to produce a wide range of ratios and test results together with statistical analyses.

(b) The database of the Government Actuary's Department has been used to provide similar details for all companies meeting the criterion of 1.4(b)(i) above; this involved a total of 45 companies.

3.2 We gratefully acknowledge the generosity of the two organisations concerned in making these facilities available for this purpose. As the leader of the research group I add my appreciation of the work put in by Peter Green and Andy Young in programming and producing the output from their respective systems.

3.3 The computer output available to the research group from these two sources was very comprehensive; and obviously too voluminous to form part of this report. However the essence of this type of investigation is that the reader should be able to study some of the material on which the results are based. Consequently the various sections of the report incorporate tables of the relevant statistics.

#### 4. Identity of the companies involved

4.1 As leader of the group I have taken the responsibility of deciding whether or not to suppress the identities of the companies whose figures were used in the research.

4.2 The following considerations seem relevant -

(a) All the data are taken from the statutory published returns.

(b) It is important in judging the results of an investigation of this nature that the reader should know the size of the portfolios involved. Thus if the results were to be presented anonymously it would be necessary to augment them with criteria of size (which in the hands of an inquisitive reader would reveal the identities anyway!).

(c) The investigation is not primarily concerned with individual company results; it is the various ratios and other tests which are under scrutiny for which purpose the published company data are merely a convenient source of material.

4.3 In the circumstances I come to the conclusion that for the most part no reasonable exception could be taken to identification of the companies; and that positively it is an aid to judging the usefulness of the tests under examination. However in certain parts of the report identities have been suppressed where the use of derived statistics might give rise to differences of interpretation.

#### 5. Structure of the Report

5.1 Having regard to the aspects of the investigation discussed in paragraph 2 above the work was divided among the individual members of the research group each of whom pursued a particular line of enquiry.

5.2 Each member has written an appropriate part of the report and in general such parts have been allowed to stand as separate contributions without any editorial amendments by me.

5.3 The separate papers are as follows:-

Paper I (Rafi Khan and Roger Harvey).

Revenue Classes Claims Ratios -

- (a) Incurred Claims/Earned Premiums
- (b) Outstanding Claims/Earned Premiums
- (c) Outstanding Claims/Paid Claims
- (d) (Outstanding Claims + UPR)/Written Premiums

Paper II (George Orros)

Risk Group Claims Ratio -

Incurred Claims/Earned Premiums

( Paper III (Bill Truckle)

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( Paper IV (Janet Lockett)

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( Paper V (Andy Young)

Chain-ladder Method

- (a) Accuracy
- (b) Derivation of a 'standard table'

Paper VI (Peter Green)

Run-off of companies' provisions.

5.4 Each Paper and its appendices forms a self-contained contribution; and for ease of reference a separate sequence of page numbers is used for each Paper (with the Paper number as prefix).

## 6. Chairman's Commentary

Having forgone the privilege of editing the separate contributions I feel it incumbent to comment briefly on each paper with the object of drawing out some common conclusions and hence lending an element of unity to the report.

## 7. Paper I

7.1 This paper is concerned with the question of whether the current year's claims ratios of an individual company can be used to test its results. This prompts the following ideas as possible lines of investigation.

7.2.1 Compare the value of the company's ratio for the current year with those of previous years. This involves consideration of the mean and standard deviation of the company's ratios over the years in question. The average coefficients of variation (SD ÷ Mean) are as follows:-

	SMALL companies	MEDIUM companies	LARGE companies
<u>MOTOR</u>			
IC/EP	.15	.07	.06
OS/EP	.17	.09	.08
OS/PAID	.24	.13	.09
(OS+UPR)/WP	.11	.07	.09
<u>LIABILITY</u>			
IC/EP	.44	.19	.17
OS/EP	.28	.14	.16
OS/PAID	.33	.17	.22
(OS+UPR)/WP	.19	.12	.13
<u>PROPERTY</u>			
IC/EP	.28	.15	.12
OS/EP	.36	.20	.17
OS/PAID	.32	.21	.14
(OS+UPR)/WP	.17	.09	.06

- 7.2.2 Compare the value of the company's ratio with that of other companies (within the entire market or an appropriate segment of it). This involves consideration of the mean and standard deviation of the ratios between companies. The coefficients of variation averaged over the 6 years in question are as follows:-

	SMALL companies	MEDIUM companies	LARGE companies
<u>MOTOR</u>			
IC/EP	.23	.14	.06
OS/EP	.42	.17	.08
OS/PAID	.48	.18	.06
(OS+UPR)/WP	.26	.12	.06
<u>LIABILITY</u>			
IC/EP	.74	.25	.28
OS/EP	.78	.23	.41
OS/PAID	.31	.21	.29
(OS+UPR)/WP	.69	.19	.33
<u>PROPERTY</u>			
IC/EP	.47	.13	.10
OS/EP	.79	.49	.18
OS/PAID	.67	.53	.13
(OS+UPR)/WP	.41	.22	.12

- 7.2.3 Compare the movements in the company's ratios from one year to another with the corresponding movements among companies generally. This involves consideration of the correlation between the company's time-series of ratios (or their movements) and the corresponding 'market' series.

The ordinary correlation coefficients were calculated as part of the programming but are not reproduced in Tables 1 to 12; they were in fact so weak as to provide no useful contribution to the problem.

An alternative approach is to rank each company according to its ratios and to examine how the rankings change from year to year. Tables 1A, 2A, 3A, 4A, exhibit this approach (for Motor business only); the ranking is shown for each of the six years 1971-1976 together with the difference from the mean rank for the whole period. The coefficient of rank correlation between each year and the mean is also shown.

- 7.3 Do the above results offer any prospect of devising a set of rules to enable the claims ratios to be used as tests of a company's viability?

The inherent variability of the results seems so wide that any formulation of rules is bound to be loose; and in the context of paragraph 2.5 above the supervisor might spend most of his time on the rocks!

## 8. Paper II

- 8.1 The claims ratios dealt with in Paper I are taken from Schedule 2; i.e. they are on a revenue basis by which all years of origin are aggregated within each year of account. This implies a sort of smoothing process because the ratios accommodate prior years' reserve adjustments which are hidden within the current year's revenue results.
- 8.2 Additionally Paper II deals with the incurred loss ratios attributable to years of origin; and distinguishes between the unadjusted (i.e. original values) and adjusted ratios (reflecting the subsequent run-off).
- 8.3 It is I think important to bear in mind that Paper II deals only with the 11 major companies. The summaries given in 7.2.1 and 7.2.2 above illustrate the markedly greater volatility of the smaller companies' experience.
- 8.4 Given the discouraging conclusion of paragraph 7.3 above the alternative ideas broached in section 3 of Paper II seem worthy of further investigation.

## 9. Papers III, IV and V

- 9.1 These papers deal with the chain-ladder method, looking at -
- (a) The accuracy of the results.
  - (b) The underlying structure of the multipliers.
- 9.2 With regard to accuracy the following observations can be made -
- (a) The range of errors, even for the largest companies, is so wide as to render the basic method useless as a means of checking claims provisions.

- (b) The inflation-adjusted method does not achieve any noticeable improvement over the basic method.
- (c) The method's results are inconsistent from one year to the next.
- (d) The results are sensitive to the choice of base-year.

9.3 With regard to the underlying set of multipliers it appears -

- (a) Each of the risk-groups investigated exhibits a characteristically different pattern of parameters.
- (b) Within each risk-group there are marked variations between companies.
- (c) For each company there are significant differences between the highest and lowest set of multipliers.

9.4 The problems implied by 9.3 discourage the idea of a 'standard table' approach. Paper V seems to confirm that this concept is fraught with difficulties. However I suggest that the pessimistic conclusion of Paper V is the inevitable consequence of requiring the standard table to achieve an accurate estimate of outstanding provisions (see paragraph 12.2.2 below).

## 10. Paper VI

10.1 This Paper analyses the development of the companies' estimates of liabilities for the 11 major companies on the NU database.

10.2 It is useful to consider the results in the context of the concept of a 'track-record'.

Taking the 'market' (i.e. the 11 companies) as a whole the track-record has the characteristics that -

- (a) It differs markedly between different risk-groups.
- (b) Within each risk-group the pattern of development varies according to year of origin. There is little sign of any consistent pattern except possibly for Fire business.

Individual company experience within the market is highly diverse with the exception of Fire business.

10.3 There seems little prospect that a company's past estimating performance could be used as a reliable guide to the run-off of its current liabilities.

## 11. Conclusions

In the context of the objectives discussed in paragraph 2 above the results of the various papers lead to the following conclusions -



- 11.1 As an historical record the conventional claims ratios of a particular company may be of interest in judging its past performance. But they are unlikely to be of much use to a supervisor as tests of the company's current provisions.
- 11.2 The chain-ladder method is unstable; and its results are not sufficiently accurate to be used with any confidence as a means of testing outstanding claims provisions.
- 11.3 There is no reason to suppose that a company's track-record of estimating provides any dependable indication of the adequacy of its current estimates.
- 11.4 I regard this line of research as being at a dead-end but this view is not shared by all the members of the group. Some consider that in the absence of any specific criteria of usefulness my conclusions are premature.

## 12. Ideas for further research

- 12.1 From the various Papers I extract two lines of enquiry which might be fruitfully subjected to deeper investigation. They are linked by the common idea that we should get away from the narrow pre-occupation with outstanding claims; and should be more concerned with the whole of the company's potential liabilities.
  - 12.2.1 Paper II paragraph 3 suggests that we should focus on the broader issue of solvency margins by measuring them against the variability of the incurred claims ratios.
  - 12.2.2 Paper V rather discourages the idea of actuarial standard tables. But an actuarial basis may be viewed as a prudent and conservative control mechanism rather than as a precise predictor of outstanding liabilities. This seems to warrant further consideration bearing in mind that such a concept would contain its own built-in solvency margin and claims equalisation features.
- 12.3 Both these lines of development carry implications for broader issues such as taxation, treatment of investment income and the specification of solvency margins.

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## DEPARTMENT OF TRADE RETURNS

The figures investigated in this analysis are derived from Schedule 2 Part III of the Department of Trade Returns, that is the consolidated general business revenue account.

The following ratios are calculated separately for each of the motor vehicle, personal accident and liability accounts.

- (i)  $\frac{\text{Incurred Claims}}{\text{Earned Premiums}}$
- (ii)  $\frac{\text{Outstanding Claims}}{\text{Earned Premiums}}$
- (iii)  $\frac{\text{Outstanding Claims}}{\text{Paid Claims}}$
- (iv)  $\frac{\text{Outstanding Claims and Unsecured Premiums}}{\text{Written Premiums}}$

They are calculated for each company producing Department of Trade returns for the whole period 1971-1976 in any one of the three classes listed above.

In assessing the nature of the data used to produce these figures it is instructive to consider the differences between the figures shown in Schedule 2 and those in Schedule 3 Parts II (claim frequency analysis) and III (claims settlement analysis).

### (i) Risk Classification

The Schedule 2 revenue accounts are for broad classes.

i.e. liability  
marine, aviation and transport  
motor vehicle  
pecuniary loss  
personal accident  
property  
treaty reinsurance

The Schedule 3 analyses break down further the classes with, for example, motor and property, split into the following risk-groups:

Motor Vehicle - private cars  
commercial vehicles  
two-wheeled vehicles  
fleet

Property - fire  
householders  
burglary  
engineering  
other

It should be noted, however, that at present it is uncommon for companies to produce analyses for each of the risk-groups shown above.

In motor for example fleet business may be shown separately or else aggregated with private cars. In property, householders business may be shown separately or aggregated with fire, and engineering may be shown separately or included, often as the main constituent, in "other property".

The risk classification used in Schedule 3 Parts II and III also involves showing analyses separately for each major territory. On the other hand when the scope of the Department of Trade returns includes overseas business, this business is included in the Schedule 2 Part III revenue accounts together with U.K. business. The geographical mix of business in the revenue accounts can therefore vary considerably from one company to another, not only in the proportion of business written in the U.K. but also in the spread of overseas business from territory to territory.

There are three particular influences on the figures arising from the inclusion of overseas business which are worth noting. First there are movements in exchange rates which in recent years have been very marked with year to year variations of up to 30% in sterling's value against major territories' currencies. Besides affecting the nature of the data, there is the practical point that outstanding claims and unearned premiums carried forward will be adjusted for changes in rates of exchange before being incorporated in the next year's revenue account as being brought forward. It is therefore necessary in calculating earned premiums and claims incurred to use data with consistent exchange rates.

Secondly, there is the point that where overseas business is written the extent to which it is included in the Department of Trade returns can vary considerably, both from company to company and from year to year. Companies may have included all the worldwide business of themselves and their subsidiaries or they may have included only that written on a branch basis, excluding overseas subsidiaries' operations. Some companies have started off with the first approach and then changed to the second. Furthermore when overseas branches are domesticated to form subsidiaries, the second approach means that their business moves outside the scope of the Returns.

The assumption by a newly formed overseas subsidiary will involve a portfolio transfer in the revenue account as would the assumption by a parent company of a formerly unconsolidated U.K. subsidiary's business. In either case the calculation of revenue account ratios will not be possible as the portfolio transfer would not be broken down into unearned premiums, unexpired risk provisions and outstanding claims.

Thirdly, the consolidation of overseas business means that those companies with large interests widely spread overseas will show, presumably, a different and less volatile pattern of results than those writing business just in the U.K. This is particularly relevant when comparing data for a group of large companies, with those for a group of small companies as the latter, almost by definition, will not have the geographical spread of business. Different characteristics shown for the large group compared with the small group may therefore be not just because of size but because of different geographical spread.

(ii) Years of Origin

The claims settlement analysis in Schedule 2 Part III allows a <sup>cohort</sup> ~~chart~~ analysis for each year of origin, using either the initial estimate of claims at the end of the year of origin or else claims developed to the end of subsequent years. The revenue account, however, only shows total claims paid and total outstanding claims at the beginning and end of the year, giving a very broad picture of claims incurred with no analysis possible of whether results have been affected by surplus or shortfalls emerging in prior years' claims provisions.

(iii) Reinsurance

The revenue account figure for claims is net of reinsurance while Schedule 3 Part III is on a gross basis. The scale of reinsurance varies from class to class with little of a large motor account being reinsured while a small property account may be very heavily reinsured. This should mean greater variability in the gross claims from year to year and between companies than for net claims.

REVENUE ACCOUNT RATIOSREVIEW OF FIGURES PRODUCED BY ANDREW YOUNG

12 Tables were produced by Andrew Young dealing with

1. Incurred Claims/Earned Premiums
2. Outstanding Claims/Earned Premiums
3. Outstanding Claims/Paid Claims
4. Outstanding Claims + Unearned Premiums/Written Premiums

These ratios were calculated for various companies for Years of Accident 1971-1976 and for Motor, Liability and Property business separately

Companies were grouped by net written premium size in 1976.

Small Companies represent 0 - 1% of Total 1976 Written Premiums  
 Medium " " 1 - 5% " " " " "  
 Large " " 5% + " " " " "

Weightings obtained were as follows:-

	Motor	Liability	Property
Small	586	377	542
Medium	3,629	2,200	2,378
Large	5,785	7,423	7,080
Total Weight	<u>10,000</u>	<u>10,000</u>	<u>10,000</u>

Let us consider each class separately.

1. MOTOR

1975 figures obtained for Co. 91 (Commercial Union) and 1976 figure for Co. 323 (Royal) are clearly anomolous.

It is interesting to compute figures for the total large group of companies leaving out these two figures the results obtained are as follows:-

<u>MOTOR - LARGE CO'S</u>	1975	1976
<u>Inc. Claims/E.P.</u>		
Mean	0.76	0.72
S.D.	0.05	0.07
Range	0.11	0.17
<u>O/S CL/E.P.</u>		
Mean	0.75	0.76
S.D.	0.03	0.07
Range	0.07	0.16
<u>O/S CL/PD CL</u>		
Mean	1.09	1.23
S.D.	0.11	0.06
Range	0.19	0.17
<u>O/S + UNE.P/W.P.</u>		
Mean	1.10	1.14
S.D.	0.05	0.10
Range	0.12	0.27

The four tables seem to show a large element of stability in ratios for the large group of companies and these account for some 56% of the motor written premium.

Standard deviation for this group is much smaller than for the other groups or indeed than the overall result.

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If one considers the revised figures for 1975 and 1976 then only on one occasion does the Standard Deviation exceed 0.10 and usually is near 0.05.

The above would suggest grounds for optimism in monitoring and assessing ratios for the large companies.

For smaller companies one should perhaps observe the correlation shown over the past few years when compared with the result for large companies and then decide as to whether statistical inferences may be made.

## 2. LIABILITY

Here inter company variation is high and this is shown by large Standard Deviations and figures obtained for Range.

It is interesting to note that the 'Medium' group of companies show a smaller variance than the large group in all the tables. 1976 figures for Royal again seem to be anomalous.

The tables seem to imply that there is little hope for statistical monitoring or assessment of the ratios derived.

## 3. PROPERTY

As for motor the All Companies result is misleading as it fails to display the consistency shown in the Large Companies' results especially for Inc. Claims/Earned Premiums and O/S CL./E.P.

In this class the large companies account for some 71% of the total business - a much greater proportion than even for motor.

The figures for standard deviations and range are of the same order as for motor.

Once again 1975 figures for Co. 91 (Commerical Union) and 1976 figures for Co. 323 seem to be anomalous and taking these figures out give the following result:-

<u>LIABILITY - LARGE CO'S</u>	1975	1976
<u>Inc.Claims/E.P.</u>		
Mean	.57	.62
S.D.	.07	.02
Range	.17	.05
<u>O/S CL./E.P.</u>		
Mean	.39	.46
S.D.	.06	.08
Range	.14	.20
<u>O/S CL./PD.CL.</u>		
Mean	.75	.91
S.D.	.10	.16
Range	.27	.40
<u>O/S CL + UN.E.P./W.P.</u>		
Mean	.79	.88
S.D.	.07	.12
Range	.15	.30

For any small company I would suggest that one looks at the correlation shown between its results and those for the large companies group over the last 6 or 7 years before deciding as to whether any inference can be drawn from future results.

Tables 13, 14 and 15 show for Motor, Liability and Property seperately the Means for years 1971 to 1976 and also the standard deviation between those Means.

The above figures are in strict order of size of companies as measured by 1976 net written premiums.

The figures obtained do seem to show that standard deviations are smaller for the larger companies and also that the Means are closer for these companies.

#### SUMMARY

There would appear to be grounds for optimism in monitoring results for motor and property classes.

For liability the variability that exists means that little inference may be drawn from any of the ratios.

NOTOR:- INC. CLAIMS/EARNED PREMIUMS RATIOS

WEIGHTS: SMALL 0-100, MEDIUM 101-500, LARGE 501 +

TOTAL WEIGHT 10,000

<u>SMALL CO'S</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>MEAN</u>	<u>S.D.</u>
7	.87	.68	.79	.88	1.01	.73	.83	.12
25	.76	.71	.19	.59	.61	.57	.57	.20
41	.68	.64	.53	.58	.60	.54	.59	.06
53	1.01	.75	.80	.88	.37	.80	.77	.22
55	.75	.65	.58	.57	.57	.54	.61	.08
56	.66	.61	.61	.59	.60	.58	.61	.03
58	.72	.59	.53	.62	.59	.57	.60	.06
86	.72	.58	.59	.67	.82	.86	.71	.12
108	.68	.83	.56	.75	.50	.56	.65	.13
115	.76	.53	.71	.56	.58	.62	.63	.09
122	.86	.91	.67	.86	.77	.67	.79	.10
123	.90	.33	1.29	1.03	.91	1.41	1.15	.22
126	.70	.58	.54	.55	.60	.60	.60	.06
132	.69	.70	.70	.57	.39	.67	.62	.12
140	.68	.71	.68	.47	.48	.60	.60	.11
170	.67	.58	.57	.64	.56	.56	.60	.04
195	.83	.71	.69	.72	.69	.74	.73	.05
211	.65	.73	.68	.69	.35	.76	.64	.15
268	.80	.67	.80	.72	.74	.59	.72	.08
274	.70	.74	.69	.81	.75	.81	.75	.05
283	.85	.97	.92	.73	.66	.78	.82	.12
379	.59	.60	.58	.69	.60	.46	.59	.07
393	.73	.62	.59	.58	.58	.54	.61	.06
402	.69	.68	.57	.60	.52	.60	.61	.07
517	.75	.99	1.18	.51	.59	.68	.78	.25
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Small Mean	.75	.72	.68	.67	.62	.67	.69	.05
Small S.D.	.09	.17	.21	.14	.16	.18	.13	
Small Range	.42	.80	.76	.56	.66	.95	.58	Wght.586

<u>MEDIUM CO'S</u>								
57	.74	.72	.69	.78	.73	.77	.74	.03
102	.66	.57	.57	.68	.62	.54	.61	.06
104	.71	.64	.63	.68	.70	.70	.68	.03
121	.80	.69	.67	.68	.67	.69	.70	.05
198	.79	.69	.70	.88	.85	.77	.78	.08
237	.65	.64	.68	.63	.67	.67	.66	.02
242	.95	.96	.90	.95	.99	.91	.95	.03
247	.70	.65	.60	.63	.61	.61	.63	.04
254	.71	.61	.53	.58	.59	.58	.60	.06
276	.76	.76	.75	.85	.77	.67	.76	.06
289	.77	.69	.79	.69	.71	.65	.72	.05
291	.76	.69	.74	.71	.71	.74	.73	.03
292	.73	.81	.77	.84	.94	.59	.78	.12
305	.69	.65	.62	.65	.75	.66	.67	.04
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Medium Mean	.74	.70	.69	.73	.74	.68	.71	.03
Medium S.D.	.07	.10	.10	.11	.12	.09	.09	
Medium Range	.30	.39	.37	.37	.40	.37	.35	Wght.3629

<u>LARGE CO'S</u>								
91	.74	.77	.78	.77	.41	.83	.72	.16
154	.69	.67	.69	.72	.80	.68	.71	.05
168	.77	.88	.75	.73	.73	.73	.77	.06
306	.70	.65	.67	.71	.71	.68	.69	.03
323	.73	.73	.76	.77	.82	.29	.63	.19
359	.73	.71	.75	.78	.75	.66	.73	.04
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Large Mean	.73	.74	.73	.75	.70	.65	.72	.04
Large S.D.	.03	.08	.04	.03	.15	.18	.03	
Large Range	.03	.23	.11	.07	.39	.54	.09	Wght.5785

<u>ALL CO'S</u>								
All Co's Mean	.74	.72	.69	.70	.67	.67		
All Co's S.D.	.08	.14	.17	.12	.15	.16		
All Co's Range	.42	.80	1.09	.57	.66	1.12	Total Wght.10,000	



NOTOR:- OUTSTANDING CLAIMS/EARNED PREMIUMS RATIOS

Table 2

WEIGHTS: SMALL 0-100, MEDIUM 101-500, LARGE 501 +

TOTAL WEIGHT 10,000

<u>SMALL CO'S</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>MEAN</u>	<u>S.D.</u>
7	.37	.20	.34	.35	.27	.24	.29	.07
25	.30	.31	.23	.41	.29	.36	.32	.06
41	.71	.72	.68	.72	.72	.67	.70	.02
53	.48	.43	.60	.53	.45	.68	.53	.10
55	.42	.46	.43	.31	.29	.26	.36	.08
56	.36	.40	.47	.44	.44	.41	.42	.04
58	.67	.63	.60	.65	.60	.58	.62	.03
86	.49	.50	.52	.57	.79	1.11	.66	.25
108	.36	.28	.29	.63	.41	.41	.40	.13
115	.69	.84	.75	.73	.59	.59	.70	.10
122	.45	.38	.26	.37	.31	.31	.35	.07
123	.60	1.57	1.20	1.30	1.03	.95	1.11	.33
126	.54	.41	.42	.43	.45	.47	.45	.05
140	.46	.50	.61	.42	.48	.60	.51	.08
170	.45	.46	.50	.51	.46	.48	.48	.02
195	.63	.59	.65	.73	.70	.66	.66	.05
211	.62	.62	.61	.56	.45	.54	.57	.07
268	.71	.84	1.21	1.21	1.54	1.36	1.15	.32
274	.73	.59	.60	.73	.71	.78	.69	.08
283	.54	.65	.74	.74	.69	.60	.66	.08
379	.39	.58	.73	.63	1.00	.93	.71	.23
393	.40	.44	.45	.46	.51	.49	.46	.04
402	.47	.51	.46	.50	.42	.46	.47	.03
Mean	.51	.56	.58	.61	.59	.61	.58	.04
Small S.D.	.13	.27	.25	.24	.29	.27	.22	
Range	.37	1.37	.98	.99	1.27	1.12	.86 Wght.	586

<u>MEDIUM CO'S</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>MEAN</u>	<u>S.D.</u>
57	.64	.61	.62	.64	.63	.68	.64	.02
102	.57	.50	.54	.72	.78	.77	.65	.12
104	.57	.54	.55	.60	.60	.61	.58	.03
121	.78	.79	.75	.81	.85	.81	.80	.03
198	.69	.60	.68	.89	.87	.86	.76	.12
237	.63	.58	.66	.76	.83	.82	.71	.10
242	.72	.75	.74	.85	.87	.83	.79	.06
247	.61	.63	.62	.63	.56	.54	.60	.04
254	.51	.49	.48	.55	.58	.56	.53	.04
276	.80	.88	.87	1.01	1.04	1.07	.94	.11
289	.74	.65	.75	.79	.84	.84	.77	.07
291	.63	.63	.60	.59	.58	.63	.61	.02
292	.57	.66	.72	.78	.85	.76	.72	.10
305	.61	.62	.65	.70	.77	.68	.67	.06
Mean	.65	.64	.66	.74	.76	.75	.70	.06
Medium S.D.	.09	.11	.10	.13	.15	.14	.11	
Range	.29	.39	.39	.46	.48	.53	.41 Wght.	3629

<u>LARGE CO'S</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>MEAN</u>	<u>S.D.</u>
91	.62	.70	.77	.79	.45	.83	.69	.14
154	.71	.69	.68	.71	.76	.72	.71	.03
168	.64	.76	.76	.82	.73	.76	.74	.06
306	.61	.60	.64	.71	.71	.67	.66	.05
323	.74	.72	.77	.79	.78	.43	.71	.14
359	.64	.63	.66	.74	.77	.83	.71	.08
Mean	.66	.68	.71	.76	.70	.71	.70	.03
Large S.D.	.05	.06	.06	.05	.13	.15	.03	
Range	.13	.16	.13	.11	.33	.40	.08 Wght.	5785

<u>ALL CO'S</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>MEAN</u>	<u>S.D.</u>
All Co's Mean	.58	.60	.62	.67	.66	.67		
All Co's S.D.	.13	.21	.20	.20	.24	.23		
Range	.50	1.37	.97	.98	1.27	1.12	Total Wght.	10,000

## NOTOR:- OUTSTANDING CLAIMS/PAID CLAIMS

Table 3

WEIGHTS: SMALL 0-100, MEDIUM 101-500, LARGE 501 +

TOTAL WEIGHT 10,000

SMALL CO'S	1971	1972	1973	1974	1975	1976	MEAN	S.D.
7	.44	.23	.56	.45	.26	.35	.38	.12
25	.39	.48	.72	.80	.44	.87	.62	.21
41	1.16	1.28	1.40	1.50	1.49	1.42	1.37	.13
53	.59	.73	1.08	.69	.85	1.11	.84	.21
55	.61	.94	.89	.61	.54	.63	.70	.17
56	.66	.82	1.05	.86	.80	.86	.84	.13
58	1.07	1.09	1.12	1.20	1.13	1.20	1.14	.06
86	1.00	1.60	1.98	1.38	1.64	1.82	1.57	.35
108	.60	.32	.60	1.25	3.06	1.30	1.19	.99
115	1.17	1.69	1.36	1.37	1.01	1.20	1.30	.23
122	.53	.44	.38	.53	.48	.63	.50	.09
126	3.38	1.56	1.38	1.07	1.06	1.09	1.59	.90
140	.64	.87	1.25	.86	.97	1.35	.99	.27
170	.81	1.01	1.01	1.02	1.02	1.04	.99	.09
195	.83	.91	1.20	1.21	1.10	1.24	1.08	.17
211	1.08	1.16	1.16	1.01	.97	.87	1.04	.11
268	1.16	2.50	2.22	2.21	2.24	3.11	2.24	.63
274	1.35	.99	1.20	1.02	1.18	1.46	1.20	.18
283	.78	1.01	1.13	1.01	.94	1.23	1.02	.16
379	.72	1.19	1.51	1.00	.92	1.30	1.11	.29
393	.63	.79	.89	.85	1.01	1.16	.89	.18
402	.80	1.00	.90	.99	.82	.96	.91	.08
Mean	.93	1.03	1.14	1.04	1.09	1.19	1.07	.09
Small S.D.	.61	.50	.43	.38	.61	.53	.40	
Range	2.99	2.27	1.84	1.76	2.80	2.76	1.85Wght.	586
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MEDIUM CO'S								
57	1.38	1.16	1.36	1.23	1.15	1.48	1.29	.13
102	.97	.99	1.25	1.58	1.66	1.76	1.37	.35
104	.91	.99	1.07	1.12	1.03	1.08	1.03	.02
121	1.18	1.37	1.15	1.38	1.41	1.44	1.32	.12
198	1.17	1.27	1.30	1.45	1.15	1.21	1.26	.11
237	1.06	1.21	1.49	1.44	1.46	1.45	1.35	.18
242	.82	.97	1.02	1.15	1.09	1.12	1.03	.12
247	.90	1.12	1.10	1.13	.94	.99	1.03	.10
254	.83	.87	1.03	1.11	1.07	1.12	1.01	.12
276	1.35	1.60	1.68	1.70	1.39	1.56	1.55	.15
289	1.11	.96	1.33	1.41	1.39	1.61	1.30	.23
291	1.23	1.15	1.06	1.15	1.04	1.39	1.17	.13
292	.62	.98	1.19	1.05	1.12	.96	.99	.20
305	.97	1.22	1.27	1.24	1.37	1.13	1.20	.14
Mean	1.04	1.13	1.24	1.30	1.23	1.31	1.21	.10
Medium S.D.	.22	.20	.19	.20	.21	.25	.17	
Range	.76	.73	.66	.65	.72	.80	.56Wght.	3629
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LARGE CO'S								
91	.93	1.09	1.20	1.14	.76	1.21	1.06	.18
154	1.11	1.15	1.14	1.14	1.11	1.23	1.15	.04
168	.88	1.18	1.05	1.04	.94	1.17	1.04	.12
306	1.03	1.10	1.18	1.22	1.17	1.22	1.16	.07
323	1.13	1.07	1.15	1.12	1.03	1.17	1.11	.05
359	.97	1.02	1.13	1.16	1.21	1.34	1.14	.14
Mean	1.01	1.10	1.14	1.14	1.04	1.22	1.11	.08
Large S.D.	.10	.06	.05	.06	.17	.06	.05	
Range	.25	.13	.15	.18	.45	.17	.12Wght.	5765
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All Co's								
Mean	.97	1.07	1.17	1.14	1.13	1.24		
All Co's S.D.	.46	.38	.33	.32	.46	.41		
Range	2.99	2.27	1.84	1.77	2.79	2.76	Total Wght.	10,000

MOTOR:- OUTSTANDING CLAIMS + UNEARNED PREMIUMS + WRITTEN PREMIUMS Table 4

WEIGHTS: SMALL 0-100, MEDIUM 101-500 LARGE 501 + TOTAL WEIGHT 10,000

<u>SMALL CO'S</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>MEAN</u>	<u>S.D.</u>
7	.75	.72	.62	.57	.54	.53	.62	.09
25	.66	.73	.75	.78	.68	.73	.72	.04
41	1.08	1.07	1.07	1.08	1.07	1.04	1.07	.02
53	.81	.75	.86	.83	.76	.93	.82	.07
55	.75	.83	.82	.69	.73	.58	.73	.09
56	.71	.72	.82	.76	.78	.74	.76	.04
58	1.02	1.02	.98	1.01	.94	.94	.99	.04
86	.72	.67	.64	.67	.89	1.24	.80	.23
108	.96	.72	.69	1.00	.76	1.04	.86	.15
115	1.03	1.45	1.11	1.11	.94	.94	1.10	.19
122	.77	.72	.63	.75	.64	.61	.69	.07
126	.82	.77	.77	.74	.74	.79	.77	.03
140	.81	.86	.95	.77	.95	.88	.87	.07
170	.83	.79	.87	.85	.85	.85	.84	.03
195	1.04	1.00	1.08	1.18	1.12	1.01	1.07	.07
211	.85	.87	.91	.97	1.00	.87	.92	.06
268	1.20	1.26	1.61	1.81	2.04	1.58	1.58	.32
274	1.01	.90	.96	1.16	1.06	1.12	1.04	.10
283	.83	.92	1.09	1.14	1.06	.88	.99	.13
379	.63	.92	1.22	1.10	1.48	1.34	1.11	.31
393	.69	.78	.80	.81	.88	.82	.80	.06
402	.79	.84	.81	.86	.79	.82	.82	.03
Mean	.85	.88	.91	.94	.94	.92	.91	.04
Small S.D.	.15	.19	.23	.26	.32	.25	.21	
Range	.57	.78	.99	1.24	1.50	1.05	.96	Wght.586
<u>MEDIUM CO'S</u>								
57	.97	.91	.93	.94	.92	.95	.94	.02
102	.93	.86	.91	1.10	1.14	1.14	1.01	.13
104	.92	.89	.89	.92	.90	.95	.91	.02
121	1.14	1.16	1.15	1.23	1.24	1.17	1.18	.04
198	.97	.92	1.05	1.22	1.21	1.23	1.10	.14
237	.96	.90	1.00	1.13	1.17	1.16	1.05	.11
242	1.07	1.08	1.09	1.19	1.17	1.16	1.13	.05
247	.95	.99	.99	.99	.89	.87	.95	.05
254	.84	.82	.82	.89	.91	.90	.86	.04
276	1.07	1.16	1.17	1.34	1.41	1.50	1.28	.17
289	1.09	1.02	1.12	1.14	1.21	1.17	1.12	.07
291	.99	.95	.92	.89	.90	.91	.93	.04
292	1.01	1.00	1.08	1.16	1.20	1.19	1.11	.09
305	.92	.97	1.04	1.07	1.11	1.03	1.02	.07
Mean	.99	.97	1.01	1.09	1.10	1.10	1.04	.06
Medium S.D.	.08	.10	.11	.14	.17	.17	.12	
Range	.30	.34	.35	.45	.52	.63	.42	Wght.3629
<u>LARGE CO'S</u>								
91	.97	1.05	1.20	1.23	.81	1.28	1.09	.18
154	1.05	1.04	1.03	1.07	1.08	1.13	1.07	.09
168	.98	1.11	1.10	1.21	1.10	1.12	1.10	.07
306	.96	.96	1.01	1.09	1.05	1.01	1.01	.05
323	1.05	1.04	1.09	1.12	1.08	1.06	1.07	.03
359	.98	.95	.99	1.07	1.17	1.18	1.06	.10
Mean	1.00	1.03	1.07	1.13	1.05	1.13	1.07	.05
Large S.D.	.04	.06	.08	.07	.12	.09	.03	
Range	.09	.16	.21	.16	.36	.27	.09	Wght.5785
<u>All Co's</u>								
Mean	.92	.93	.97	1.02	1.01	1.01		
All Co's S.D.	.14	.16	.19	.22	.26	.22		
Range	.57	.78	.99	1.23	1.49	1.05	Total Wght.10,000	

# LIABILITY:- INCURRED CLAIMS + EARNED PREMIUMS

Table 5

WEIGHTS: SMALL 0-100, MEDIUM 101-500, LARGE 501 + TOTAL WEIGHT 10,000

SMALL CO'S	1971	1972	1973	1974	1975	1976	MEAN	S.D.
7	.92	.77	.97	.83	.65	.75	.82	.12
41	.68	.75	1.00	1.31	.62	.51	.81	.29
55	.64	1.23	2.56	1.30	1.52	.30	1.26	.73
58	.41	.40	.49	.32	.39	.36	.40	.05
69	.71	1.00	.55	.77	.55	1.01	.77	.21
102	.93	.71	.76	.68	.66	.59	.72	.12
108	.97	.72	.95	.46	.34	.71	.69	.26
122	.26	.25	.50	.45	.57	.41	.41	.13
123	.47	.91	.87	1.04	.99	1.40	.95	.30
140	.29	.93	.70	.48	.89	.15	.57	.32
181	.71	6.07	.82	.90	1.76	1.08	1.89	2.08
195	.65	.71	.67	.78	.82	.78	.73	.07
237	.51	.55	1.25	.89	1.00	.51	.78	.31
522	.76	.88	.66	.93	1.12	3.72	1.35	1.17
274	1.06	.95	.73	.65	.81	.54	.79	.19
283	.96	1.13	1.37	.85	.12	.44	.81	.46
289	.56	.60	.83	.81	.78	.46	.67	.15
373	1.50	.67	.25	.50	.13	.67	.62	.48
391	.13	.26	.32	.30	.21	.20	.24	.07
393	.24	.14	.83	.36	.62	.46	.44	.25
402	.39	.04	.34	.14	.25	.04	.20	.15
543	.35	.24	.32	.50	.64	.98	.50	.27
254	1.12	.68	.35	.67	.67	.45	.66	.27
Mean	.66	.90	.79	.69	.70	.72	.74	.09
Small S.D.	.34	1.17	.49	.30	.40	.73	.37	
Range	1.26	6.03	2.31	1.16	1.64	3.68	1.69	Wght.377
MEDIUM CO'S								
104	.68	.65	.75	.84	.73	.56	.70	.10
115	.66	.58	1.12	1.02	1.19	.82	.90	.25
198	.71	.69	.74	.95	.82	.57	.75	.13
242	.89	.99	.97	1.16	1.21	1.26	1.08	.15
248	.84	.67	.70	.92	.63	.53	.71	.14
276	.66	.74	.79	.86	.75	.58	.73	.10
292	.67	.74	.89	1.02	.80	.11	.70	.32
305	.49	.65	.61	.64	.70	.55	.61	.08
306	.62	.60	.66	.54	.60	.68	.62	.05
Mean	.69	.70	.80	.88	.83	.63	.76	.10
Medium S.D.	.12	.12	.16	.19	.22	.30	.15	
Range	.40	.41	.51	.62	.61	1.15	.47	Wght.2200
LARGE CO'S								
91	.72	.88	.97	.78	.67	.86	.81	.11
121	1.24	.37	1.40	1.46	1.62	1.10	1.20	.44
154	.69	.70	.75	.83	.94	.68	.77	.10
168	.67	1.11	.96	.75	.62	.80	.82	.19
247	.71	.77	.77	.71	.84	.84	.77	.06
323	.84	.82	.91	.93	.85	.39	.79	.20
359	.77	.72	.93	.75	.69	.76	.77	.08
Mean	.81	.77	.96	.89	.89	.78	.85	.08
Large S.D.	.20	.22	.21	.26	.34	.21	.16	
Range	.57	.74	.63	.75	1.00	.71	.43	Wght.7423
All Co's								
Mean	.69	.83	.82	.77	.76	.71		
S.D.	.28	.90	.39	.39	.36	.58		
Range	1.38	6.02	2.31	2.31	1.64	3.68	Total Wght.10,000	

LIABILITY:- OUTSTANDING CLAIMS/EARNED PREMIUMS RATIOS

Table 9

WEIGHT: SMALL 0-100, MEDIUM 101-500, LARGE 501+

TOTAL WEIGHT 10,000

SMALL CO'S		1971	1972	1973	1974	1975	1976	MEAN	S.D.
7		.67	.81	1.10	1.27	.81	1.04	.95	.22
41		1.49	1.58	2.11	2.83	2.28	2.00	2.05	.49
55		1.82	3.32	8.11	3.35	3.72	2.24	3.76	2.25
58		.59	.62	.89	.89	.90	.89	.80	.15
69		1.00	1.36	.94	1.39	.50	1.14	1.07	.30
102		1.79	1.58	1.56	1.64	1.68	1.44	1.61	.12
108		1.19	1.20	1.77	1.24	1.12	1.33	1.31	.24
122		.52	.50	.75	.93	1.02	.85	.76	.21
123		.69	.92	.91	1.34	1.56	1.46	1.15	.35
140		.87	1.39	1.73	1.33	1.79	1.95	1.51	.39
181		1.91	8.67	6.65	5.48	6.05	5.44	5.70	2.20
195		1.55	1.49	1.43	1.50	1.60	1.46	1.51	.06
237		1.25	1.06	1.64	1.97	2.25	2.67	1.81	.61
274		1.69	1.79	1.39	1.29	1.29	.91	1.39	.31
283		2.92	2.16	2.26	2.15	1.43	1.06	2.00	.66
289		1.23	1.36	1.65	1.84	1.99	1.54	1.60	.29
402		.60	.28	.61	.43	.42	.25	.46	.21
543		.80	.59	.82	1.04	1.73	1.85	1.10	.56
254		.91	1.12	1.08	1.21	1.43	.74	1.08	.24
Mean		1.24	1.67	1.97	1.74	1.77	1.59	1.66	.24
S.D.		.61	1.83	1.98	1.13	1.28	1.10	1.20	
Range		2.40	8.39	7.50	5.05	5.63	5.19	5.24	Wght. 377
MEDIUM CO'S									
104		.99	.96	1.13	1.31	1.37	1.20	1.16	.16
115		.94	1.30	1.74	2.30	2.41	1.86	1.76	.57
198		1.30	1.07	.96	1.19	1.26	1.09	1.15	.13
242		1.65	1.60	1.59	1.86	2.08	2.32	1.85	.30
248		1.52	1.24	1.22	1.55	1.43	1.18	1.36	.16
276		1.40	1.59	1.65	1.77	1.84	2.02	1.71	.21
292		1.16	1.34	1.59	1.85	2.02	1.74	1.62	.32
305		1.33	1.38	1.30	1.24	1.36	1.22	1.30	.06
306		1.03	1.06	1.15	1.17	1.14	1.17	1.12	.06
Mean		1.26	1.28	1.37	1.58	1.66	1.53	1.45	.17
S.D.		.25	.23	.28	.39	.44	.46	.29	
Range		.71	.64	.78	1.13	1.27	1.23	.59	Wght. 2200
LARGE CO'S									
91		1.29	1.80	2.03	2.05	1.85	2.41	1.90	.37
121		2.80	3.09	3.00	4.85	5.37	2.69	3.63	1.16
154		1.46	1.52	1.53	1.61	1.82	1.67	1.60	.13
168		1.09	1.53	1.61	1.86	1.59	1.58	1.54	.25
247		1.42	1.36	1.28	1.18	1.15	1.62	1.34	.17
323		1.47	1.58	1.69	1.87	1.83	1.18	1.60	.26
359		1.64	1.71	1.90	1.92	1.79	2.00	1.83	.14
Mean		1.60	1.80	1.86	2.19	2.20	1.88	1.92	.23
S.D.		.56	.59	.56	1.21	1.42	.52	.78	
Range		1.71	1.73	1.72	3.67	4.22	1.51	2.29	Wght. 7423
All Co's									
Mean		1.31	1.60	1.79	1.79	1.83	1.63		
S.D.		.54	1.37	1.49	1.01	1.14	.87		
Range		2.41	8.38	7.50	5.05	5.63	5.19	Total Wght. 10,000	

LIABILITY:- OUTSTANDING CLAIMS/PAID CLAIMS

WEIGHT: SMALL 0-100, MEDIUM 101-500, LARGE 501 + TOTAL WEIGHT 10,000

<u>SMALL CO'S</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>MEAN</u>	<u>S.D.</u>
7	1.08	1.20	1.83	2.38	3.51	3.08	2.18	.99
55	2.11	2.15	3.17	2.96	4.23	2.55	2.86	.79
58	3.04	2.49	4.97	4.58	3.68	4.64	3.90	.99
102	3.63	3.85	3.99	4.46	4.19	4.21	4.06	.29
108	3.07	2.62	4.02	3.94	4.29	2.70	3.44	.73
122	3.22	2.63	3.84	6.12	4.76	4.78	4.22	1.26
123	1.70	2.03	1.90	2.06	4.55	6.75	3.16	2.05
140	1.65	4.02	6.33	3.86	5.68	4.12	4.29	1.63
181	2.48	4.64	3.65	6.76	5.08	4.69	4.55	1.44
195	3.53	3.45	4.49	3.93	5.64	6.16	4.53	1.13
237	2.32	3.14	4.15	5.42	3.77	5.92	4.12	1.36
274	4.50	3.09	3.83	5.15	2.94	3.73	3.87	.84
283	3.04	1.57	5.81	8.95	4.75	7.31	5.24	2.72
289	3.15	2.48	3.08	6.46	4.42	3.88	3.91	1.42
<hr/>								
Small Co's	Mean	2.75	2.81	3.93	4.79	4.39	4.61	3.88 .90
	S.D.	.91	.96	1.26	1.87	.78	1.47	.77
	Range	3.42	3.44	4.50	6.89	2.74	4.20	3.06 Wght. 377
<hr/>								
<u>MEDIUM CO'S</u>								
104	2.29	2.44	2.99	3.05	2.90	3.27	2.82	.38
115	3.50	3.65	3.98	5.45	5.10	5.15	4.47	.86
198	2.48	2.12	2.42	3.23	3.07	3.08	2.73	.45
242	2.54	2.76	3.27	3.51	3.92	4.75	3.46	.81
248	3.18	2.73	3.31	3.43	3.83	3.34	3.30	.36
276	3.02	3.82	4.30	3.60	2.44	2.77	3.32	.70
292	1.93	3.58	4.33	4.07	3.80	2.47	3.36	.95
305	2.97	3.41	4.09	3.18	3.63	3.93	3.53	.43
306	2.69	2.95	3.04	3.04	3.10	3.81	3.10	.38
<hr/>								
Medium Co's	Mean	2.73	3.05	3.53	3.62	3.53	3.62	3.34 .37
	S.D.	.48	.59	.67	.76	.77	.89	.50
	Range	1.57	1.70	1.91	2.41	2.66	2.68	1.74 Wght.2200
<hr/>								
<u>LARGE CO'S</u>								
91	2.74	3.86	3.45	3.45	3.04	4.39	3.49	.58
121	4.57	3.19	1.44	5.52	7.14	4.63	4.41	1.95
154	2.75	2.85	2.80	2.97	3.52	4.01	3.15	.51
168	1.95	3.13	2.92	1.07	2.80	3.77	2.61	.96
247	2.41	2.65	2.43	2.40	2.62	3.13	2.61	.28
323	2.60	2.74	2.95	2.96	3.05	4.31	3.10	.61
359	3.28	3.94	4.30	3.97	4.05	4.52	4.01	.42
<hr/>								
Large Co's	Mean	2.90	3.19	2.90	3.19	3.75	4.11	3.34 .49
	S.D.	.84	.52	.88	1.37	1.57	.52	.68
	Range	2.62	1.20	2.86	4.45	4.52	1.50	1.80 Wght.7423
<hr/>								
All Co's	Mean	2.78	2.97	3.57	4.06	3.98	4.20	
	S.D.	.77	.77	1.08	1.62	1.05	1.19	
	Range	3.49	3.44	4.90	7.88	4.69	4.84	Total Wght.10,000

LIABILITY:- OUTSTANDING CLAIMS + UNEARNED PREMIUMS/WRITTEN PREMIUMS RATIO

WEIGHT: - SMALL 0-100, MEDIUM 101-500, LARGE 501 + TOTAL WEIGHT 10,000

<u>SMALL CO'S</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>MEAN</u>	<u>S.D.</u>
7	1.10	1.50	1.50	2.29	.85	1.10	1.39	.51
58	.92	1.02	1.24	1.23	1.24	1.23	1.15	.14
102	2.16	1.83	1.81	2.11	1.92	1.74	1.93	.17
108	1.57	1.50	2.01	1.58	1.46	1.68	1.63	.20
122	.86	.89	1.10	1.27	1.27	1.16	1.09	.18
123	1.07	1.16	1.16	2.00	1.62	1.64	1.44	.37
140	1.23	1.78	2.07	1.53	2.45	1.87	1.82	.43
181	7.10	7.26	7.12	7.38	6.19	3.71	6.46	1.41
195	1.84	1.71	1.83	1.76	1.82	1.70	1.77	.06
237	1.53	1.31	1.93	2.21	2.52	2.86	2.06	.59
274	2.00	1.92	1.61	1.61	1.45	1.24	1.64	.29
283	2.94	2.30	2.44	2.45	1.52	1.37	2.18	.59
289	1.56	1.99	1.87	2.13	2.28	1.80	1.94	.25

Small Co's	Mean	1.99	2.01	2.13	2.27	2.05	1.78	2.04	.16
	S.D.	1.64	1.63	1.55	1.58	1.34	.74	1.37	
	Range	6.24	6.37	6.02	6.15	5.34	2.61	5.37	Wght. 377

MEDIUM CO'S

104	1.30	1.21	1.41	1.53	1.61	1.42	1.41	.15
115	1.23	1.72	2.19	2.56	2.59	1.90	2.03	.52
198	1.65	1.32	1.20	1.38	1.49	1.38	1.40	.15
242	1.85	1.77	1.76	1.96	2.18	2.42	1.99	.26
248	1.78	1.48	1.53	1.87	1.64	1.52	1.64	.16
276	1.64	1.76	1.93	2.06	2.34	2.41	2.02	.31
292	1.52	1.61	1.82	2.17	2.38	2.14	1.94	.34
305	1.60	1.63	1.57	1.54	1.62	1.53	1.58	.04
306	1.37	1.38	1.49	1.51	1.43	1.45	1.44	.06

Medium Co's	Mean	1.55	1.54	1.66	1.84	1.92	1.80	1.72	.16
	S.D.	.21	.20	.30	.39	.45	.43	.28	
	Range	.62	.56	.99	1.18	1.16	1.04	.63	Wght. 2200

LARGE CO'S

91	1.59	2.05	2.37	2.50	2.30	2.87	2.28	.43
121	3.16	3.25	3.42	5.13	5.13	2.18	3.71	1.18
154	1.79	1.81	1.87	1.91	2.03	2.15	1.93	.14
168	1.44	1.84	1.99	2.09	1.84	1.74	1.82	.22
247	1.71	1.60	1.58	1.46	1.51	1.82	1.61	.13
323	1.73	1.84	1.94	2.12	2.08	2.03	1.96	.15
359	1.93	1.94	2.18	2.17	2.10	2.27	2.10	.14

Large Co's	Mean	1.91	2.05	2.19	2.48	2.43	2.15	2.20	.22
	S.D.	.57	.55	.59	1.21	1.22	.37	.70	
	Range	1.72	1.65	1.84	3.67	3.62	1.13	2.10	Wght. 7423

All Co's	Mean	1.83	1.88	2.00	2.19	2.10	1.87		
	S.D.	1.13	1.12	1.09	1.22	1.09	.59		
	Range	6.24	6.37	6.01	6.14	5.34	2.61	Total Wght.	10,000

## PROPERTY:- INCURRED CLAIMS/EARNED PREMIUMS

Table 9

WEIGHT:- SMALL 0-100, MEDIUM 101-500, LARGE 501 + TOTAL WEIGHT 10,000

SMALL CO'S	1971	1972	1973	1974	1975	1976	MEAN	S.D.
7	.65	.59	.62	.73	.67	.77	.67	.06
8	.47	.91	.38	.29	.30	.60	.49	.23
41	.49	.41	.41	.54	.59	.65	.51	.10
53	.76	.58	.59	.71	.39	.70	.62	.13
55	.41	.57	1.18	.64	.58	.62	.70	.24
56	.43	.44	.51	.50	.47	.81	.53	.14
57	.61	.59	.69	.53	.58	.81	.64	.10
58	.35	.35	.33	.39	.48	.63	.42	.12
69	.41	.21	.63	.73	.70	.84	.59	.24
108	.48	.44	.38	.51	.55	.54	.48	.07
114	.45	.31	.18	.50	.60	.67	.45	.18
115	.41	.34	.36	.80	.56	.69	.53	.19
122	.41	.49	.53	.51	.63	.65	.54	.09
123	.45	.48	.48	.51	.64	.57	.52	.07
126	1.13	.31	.55	1.25	1.10	.57	.82	.39
132	.40	.42	.33	.66	.30	.64	.46	.15
140	.55	.60	.60	.72	.70	.77	.66	.08
146	.17	.16	.16	.08	.03	.29	.15	.09
181	.86	.76	.85	.93	.71	.91	.84	.09
183	.20	.18	.17	.23	.26	.34	.23	.06
195	.48	.47	.59	.80	.97	1.43	.79	.37
211	.73	.48	.56	.59	3.56	.65	1.09	1.21
237	.48	.57	.54	.61	.65	.78	.60	.10
247	.44	.42	.46	.57	.51	.57	.50	.07
250	.67	1.00	.33	.33	.25	.63	.53	.28
254	.69	.64	.63	.68	.65	.69	.67	.03
268	.54	.51	.39	.59	.70	.72	.58	.12
274	.64	.67	.59	.75	.79	.77	.70	.08
283	.65	.71	.57	.66	.75	.78	.69	.08
291	.52	.54	.62	.59	.61	.58	.58	.04
373	.07	.18	.33	.28	.40	.59	.31	.18
391	.42	.45	.40	.38	.43	.42	.42	.02
393	.43	.48	.46	.50	.67	.62	.53	.10
402	.31	.35	.36	.39	.45	.62	.41	.11
517	1.31	.74	.82	.51	.97	1.14	.91	.29
522	.53	1.52	.94	.93	1.00	.91	.97	.32
Mean	.53	.52	.51	.58	.67	.69	.58	.08
SMALL CO'S S.D.	.24	.26	.21	.22	.54	.20	.19	
Range	1.24	1.36	1.02	1.17	3.53	1.14	.94Wght.	542
<u>MEDIUM CO'S</u>								
102	.42	.45	.39	.55	.50	.63	.49	.09
104	.45	.44	.51	.59	.58	.59	.52	.07
121	.52	.47	.44	.54	.55	.69	.54	.09
198	.41	.39	.42	.54	.57	.67	.50	.11
242	.56	.58	.60	.77	.73	.82	.68	.11
248	.55	.56	.54	.49	.51	.70	.56	.07
276	.48	.51	.53	.56	.50	.53	.52	.03
289	.45	.43	.49	.57	.62	.66	.54	.09
292	.48	.52	.53	.56	.50	.41	.50	.05
305	.51	.49	.53	.42	.56	.70	.54	.09
Mean	.48	.48	.50	.56	.56	.64	.54	.06
MEDIUM CO'S S.D.	.05	.06	.06	.08	.07	.11	.05	
Range	.15	.19	.21	.35	.23	.41	.19Wght.	2378
<u>LARGE CO'S</u>								
91	.54	.54	.52	.59	.52	.61	.55	.04
154	.56	.54	.54	.69	.66	.61	.60	.06
168	.54	.60	.52	.56	.52	.60	.56	.04
306	.43	.48	.47	.57	.59	.63	.53	.08
323	.53	.52	.52	.62	.60	.37	.53	.09
359	.50	.49	.48	.54	.49	.65	.53	.07
Mean	.52	.53	.51	.60	.56	.58	.55	.04
LARGE CO'S S.D.	.05	.04	.03	.05	.06	.10	.03	
Range	.13	.22	.07	.15	.17	.28	.07Wght.	7080
<u>ALL CO'S</u>								
Mean	.52	.52	.51	.58	.64	.67		
S.D.	.20	.21	.18	.19	.45	.18		
Range	1.24	1.37	1.02	1.17	3.53	1.14Total Wght.	10,000	



## PROPERTY:- OUTSTANDING CLAIMS/EARNED PREMIUMS

Table 10

WEIGHT: SMALL 0-100, MEDIUM 101-500, LARGE 501 + TOTAL WEIGHT 10,000

SMALL CO'S	1971	1972	1973	1974	1975	1976	MEAN	S.D.
7	.28	.26	.29	.40	.36	.36	.33	.06
8	.45	1.19	.95	.70	.82	.99	.85	.26
41	.21	.22	.23	.31	.35	.43	.29	.09
53	.51	.41	.53	.38	.38	.69	.48	.12
55	.31	.38	.68	.44	.41	.45	.45	.13
56	.20	.15	.29	.19	.28	.31	.24	.07
57	.22	.22	.18	.20	.22	.35	.23	.06
58	.11	.11	.11	.10	.16	.20	.13	.04
69	.25	.25	.40	.59	.33	.33	.36	.13
108	.17	.16	.14	.18	.17	.16	.16	.01
114	.45	.38	.27	.50	.50	.53	.44	.10
115	.47	.65	.51	.62	.54	.50	.55	.07
122	.28	.33	.43	.43	.78	.85	.52	.24
123	.32	.29	.28	.39	.52	.48	.38	.10
126	.67	.31	.58	.88	1.23	.79	.74	.31
132	.52	.94	.07	.20	.58	1.00	.55	.38
140	.26	.27	.36	.39	.41	1.85	.59	.62
146	.56	.11	.13	.19	.12	.27	.23	.17
181	.92	2.16	1.99	1.57	1.37	1.75	1.63	.45
183	.03	.01	.04	.03	.05	.08	.04	.02
195	.46	.47	.63	.58	.87	1.30	.72	.32
211	.38	.34	.36	.36	2.11	.34	.65	.72
237	.26	.39	.35	.34	.34	.44	.35	.06
247	.22	.22	.27	.34	.35	.38	.29	.07
250	.33	1.00	.33	.33	.25	.50	.46	.28
254	.46	.38	.39	.41	.46	.45	.43	.03
268	.25	.36	.26	.36	.43	.58	.37	.12
274	.32	.42	.44	.52	.45	.37	.42	.07
283	.30	.30	.24	.31	.35	.36	.31	.04
291	.06	.05	.07	.08	.07	.08	.07	.01
393	.31	.28	.28	.25	.39	.37	.31	.06
402	.08	.09	.14	.14	.19	.32	.16	.09
517	.62	.63	1.05	.68	.87	.94	.80	.18
522	.34	.74	.94	1.48	1.52	1.95	1.16	.59
Mean	.34	.43	.42	.44	.54	.61	.46	.10
SMALL CO'S S.D.	.19	.41	.37	.33	.45	.48	.32	
Range	.81	21.5	1.95	1.54	2.06	1.87	1.59Wght.	542
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MEDIUM CO'S								
102	.12	.12	.13	.22	.23	.32	.19	.08
104	.25	.22	.27	.30	.32	.35	.28	.05
121	.37	.37	.37	.40	.42	.56	.41	.07
198	.21	.21	.25	.32	.35	.50	.31	.11
242	.59	.60	.82	.91	.86	.93	.78	.15
248	.19	.21	.24	.18	.18	.22	.20	.02
276	.30	.36	.41	.43	.41	.45	.40	.05
289	.26	.26	.28	.32	.36	.42	.32	.06
292	.31	.47	.47	.49	.45	.48	.44	.07
305	.24	.29	.35	.25	.30	.31	.29	.04
Mean	.28	.31	.36	.38	.39	.45	.36	.06
MEDIUM CO'S S.D.	.13	.14	.19	.21	.19	.20	.17	
Range	.47	.48	.69	.73	.68	.71	.59Wght.	2378
<hr/>								
LARGE CO'S								
91	.34	.36	.43	.44	.39	.57	.42	.08
154	.32	.32	.35	.43	.42	.42	.38	.05
168	.33	.45	.41	.50	.47	.51	.44	.07
306	.22	.25	.26	.32	.33	.37	.29	.06
323	.35	.35	.37	.42	.42	.30	.37	.05
350	.26	.27	.30	.33	.33	.45	.33	.07
Mean	.30	.33	.35	.41	.39	.44	.37	.05
LARGE CO'S S.D.	.05	.07	.06	.07	.06	.10	.06	
Range	.13	.20	.15	.18	.14	.27	.15Wght.	7080
<hr/>								
ALL CO'S								
Mean	.32	.39	.40	.42	.49	.56		
ALL CO'S S.D.	.16	.34	.32	.29	.38	.41		
Range	.89	2.15	1.95	1.54	2.06	1.87	Total Wght.	10,000

PROPERTY:- OUTSTANDING CLAIMS/PAID CLAIMS

Table 11

WEIGHT: SMALL 0-100, MEDIUM 101-500, LARGE 501 +

TOTAL WEIGHT 10,000

<u>SMALL CO'S</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>MEAN</u>	<u>S.D.</u>
7	.42	.46	.56	.82	.61	.54	.57	.14
41	.48	.62	.65	.71	.73	.82	.67	.11
53	.88	.76	1.22	.59	.91	1.22	.93	.25
55	.45	.69	.61	.82	.69	.87	.69	.15
56	.54	.29	.77	.30	.94	.43	.54	.26
57	.43	.47	.26	.35	.36	.45	.39	.08
58	.34	.32	.36	.27	.38	.35	.34	.04
69	.59	1.44	1.08	1.39	.46	.45	.90	.46
108	.37	.39	.40	.39	.34	.33	.37	.03
114	1.00	1.25	.75	1.00	1.25	1.14	1.07	.19
115	.94	1.62	1.29	.86	1.09	.85	1.11	.30
122	.75	.80	1.10	.93	3.19	1.74	1.42	.94
123	.66	.63	.69	.97	1.12		.90	.30
126	1.43	1.70	3.27	1.03	2.14	2.40	2.00	.79
140	.52	.45	.74	.67	.21	1.50	.68	.44
146	2.10	.97	.87	.82	.56	2.00	1.22	.66
181	1.45	1.84	2.26	1.79	3.02	3.00	2.23	.66
183	.13	.06	.25	.13	.19	.27	.17	.08
195	1.06	1.03	2.28	.83	1.27	1.19	1.28	.52
211	.61	.78	.79	.70	.61	.66	.69	.08
237	.46	.97	.71	.61	.57	.73	.67	.17
247	.48	.55	.72	.69	.77	.77	.66	.12
250	.50	.50	1.00	1.00	1.00	2.00	1.00	.55
254	.78	.65	.71	.65	.78	.66	.70	.06
268	.45	.98	.67	.85	.78	1.06	.80	.22
274	.49	.89	1.13	.84	.61	.47	.74	.26
283	.41	.44	.43	.59	.51	.53	.49	.07
291	.13	.09	.13	.14	.12	.15	.13	.02
393	.68	.69	.67	.54	.80	.69	.68	.08
402	.26	.30	.49	.40	.50	.68	.44	.15
517	.88	1.70	2.75	1.16	.86	1.22	1.43	.72
522	.50	.53	1.76	2.67	1.76	2.05	1.55	.86
<hr/>								
Mean	.66	.78	.98	.80	.91	1.02	.86	.14
S.D.	.41	.47	.73	.49	.72	.68	.48	
Range	1.97	1.70	3.14	2.54	3.07	2.85	2.10	Wght. 542
<hr/>								
<u>MEDIUM CO'S</u>								
102	.27	.28	.37	.50	.52	.65	.43	.15
104	.62	.52	.61	.60	.62	.75	.62	.07
121	.76	.87	.98	.90	.86	1.12	.91	.12
198	.61	.59	.75	.74	.74	1.09	.75	.18
242	1.20	1.27	3.76	1.62	1.67	1.85	1.90	.95
248	.38	.41	.50	.34	.35	.35	.39	.06
276	.70	.89	.94	.90	.83	.88	.86	.09
289	.56	.65	.65	.65	.68	.74	.65	.06
292	.59	1.22	1.11	1.01	1.00	.97	.98	.21
305	.50	.65	.88	.56	.62	.52	.62	.14
<hr/>								
Mean	.62	.74	1.06	.78	.79	.89	.81	.15
S.D.	.25	.33	.98	.36	.36	.41	.43	
Range	.93	.99	3.39	1.28	1.32	1.50	1.51	Wght. 2378
<hr/>								
<u>LARGE CO'S</u>								
91	.67	.72	.91	.84	.76	1.13	.84	.17
154	.63	.68	.73	.75	.68	.79	.71	.06
168	.63	.94	.81	.95	.91	.97	.87	.13
306	.53	.63	.63	.66	.64	.73	.64	.06
323	.69	.74	.80	.77	.78	.93	.79	.08
359	.56	.57	.76	.71	.73	.94	.71	.14
<hr/>								
Mean	.62	.71	.77	.78	.75	.92	.76	.10
S.D.	.06	.13	.09	.10	.09	.14	.09	
Range	.16	.37	.28	.29	.27	.40	.23	Wght. 7080
<hr/>								
Mean	.65	.76	.97	.79	.86	.98		
S.D.	.35	.41	.74	.45	.61	.59		
Range	1.97	1.78	3.63	2.54	3.08	2.85	Total Wght. 10,000	

PROPERTY:- OUTSTANDING CLAIMS + UNEARNED PREMIUM/WITTEN PREMIUMS Table 12

WEIGHT: SMALL 0-100, MEDIUM 101-500, LARGE 501 +					TOTAL WEIGHT 10,000			
SMALL CO'S	1971	1972	1973	1974	1975	1976	MEAN	S.D.
7	.65	.62	.66	.72	.71	.70	.68	.04
41	.61	.62	.62	.70	.74	.81	.68	.08
53	.82	.72	.80	.73	.70	.98	.79	.10
55	.73	.74	1.01	.67	.68	.70	.76	.13
56	.73	.65	.76	.70	.65	.68	.69	.05
57	.48	.40	.40	.52	.59	.80	.53	.15
58	.53	.51	.51	.50	.56	.61	.54	.04
69	.72	.75	.86	1.13	.78	.84	.85	.15
108	.53	.53	.49	.60	.60	.60	.56	.05
114	.65	.83	.57	.71	.70	.67	.69	.09
115	.87	1.11	.97	1.01	.90	.85	.95	.10
122	.65	.72	.80	.82	1.14	1.21	.89	.23
123	.72	.66	.66	.81	.86	.74	.74	.08
126	.88	.55	.76	1.08	1.37	.92	.93	.28
140	.66	.72	.76	.65	1.25	1.52	.93	.37
146	.87	.56	.51	.84	.41	.49	.61	.19
181	.08	2.30	2.28	1.92	1.77	1.58	1.82	.46
183	.47	.45	.46	.44	.47	.50	.47	.02
195	.94	.92	1.00	1.03	1.37	1.67	1.15	.30
237	.67	.81	.73	.70	.69	.78	.73	.05
247	.61	.60	.66	.71	.70	.70	.66	.05
250	.60	1.50	1.00	.67	.60	.80	.86	.35
254	.79	.70	.72	.76	.81	.79	.76	.04
268	.65	.74	.62	.72	.78	.92	.74	.11
274	.74	.81	.84	.94	.85	.78	.83	.07
283	.73	.68	.59	.64	.71	.70	.68	.05
291	.39	.44	.45	.42	.51	.57	.46	.06
393	.66	.66	.65	.63	.77	.72	.68	.05
402	.49	.50	.55	.54	.59	.72	.57	.08
517	.91	.83	1.19	.81	1.03	1.06	.97	.15
522	.68	1.40	1.28	1.89	2.04	2.56	1.64	.66
SMALL CO'S	Mean	.70	.78	.78	.81	.85	.90	.80
	S.D.	.15	.37	.35	.34	.37	.42	.29
	Range	.69	1.90	1.88	1.50	1.63	2.07	1.36 Wght. 542
MEDIUM CO'S								
102	.52	.52	.52	.63	.62	.71	.59	.08
104	.64	.62	.67	.70	.70	.72	.67	.04
121	.78	.76	.73	.78	.81	.92	.80	.07
198	.60	.61	.62	.68	.72	.85	.68	.09
242	.97	.97	1.23	1.32	1.18	1.28	1.16	.15
248	.61	.61	.64	.58	.61	.66	.62	.03
276	.58	.70	.77	.79	.79	.84	.75	.09
289	.70	.70	.71	.72	.77	.80	.73	.04
292	.72	.90	.89	.90	.83	.91	.86	.07
305	.62	.69	.78	.71	.71	.66	.69	.06
MEDIUM CO'S	Mean	.67	.71	.76	.78	.77	.84	.76
	S.D.	.13	.14	.19	.21	.16	.18	.16
	Range	.45	.45	.71	.74	.57	.62	.57 Wght. 2378
LARGE CO'S								
91	.73	.74	.95	.94	.83	1.04	.87	.12
154	.84	.83	.85	.91	.87	.94	.87	.04
168	.74	.88	.80	.86	.84	.88	.83	.05
306	.66	.69	.69	.73	.72	.74	.71	.03
323	.84	.81	.82	.85	.82	.80	.82	.02
359	.63	.64	.66	.69	.70	.78	.68	.05
LARGE CO'S	Mean	.74	.77	.80	.83	.80	.86	.80
	S.D.	.09	.09	.11	.10	.07	.11	.08
	Range	.21	.24	.29	.25	.15	.30	.19 Wght. 7080
ALL CO'S								
ALL CO'S	Mean	.69	.76	.78	.80	.83	.88	
	S.D.	.14	.31	.30	.29	.31	.35	
	Range	.69	1.91	1.88	1.50	1.63	2.06	Total Wght. 10,000

Table 13

		MOTOR							
		IC/EP		OSCL/EP		OSCL/PDCL		OSCL + UP/WP	
		MEAN		MEAN		MEAN		MEAN	
		1971-1976	S.D.	1971-1976	S.D.	1971-1976	S.D.	1971-1976	S.D.
108		0.65	0.13	.40	.13	1.19	0.99	.86	.15
7		0.83	0.12	.29	.07	.38	.12	.62	.09
122		0.79	0.10	.35	.07	.50	.09	.69	.07
123		1.15	0.22	1.11	.33	1.59	.90	-	-
140		0.60	0.11	.51	.08	.99	.27	.87	.07
379		0.59	0.07	.71	.23	1.11	.29	1.11	.31
268		0.72	0.08	1.15	.32	2.24	.63	1.58	.32
25		0.57	0.20	.32	.06	.62	.21	.72	.04
402		0.61	0.07	.47	.03	.91	.08	.82	.03
393		0.61	0.06	.46	.04	.89	.18	.80	.06
Mean		.71	.12	.58	.14	1.04	.38	.90	.13
S.D.		.18		.31		.55		.29	
170		0.60	0.04	.48	.02	.99	.09	.84	.03
53		.77	.22	.53	.10	.84	.21	.82	.07
56		.61	.03	.42	.04	.84	.13	.76	.04
58		.60	.06	.62	.03	1.14	.06	.99	.04
55		.61	.08	.36	.08	.70	.17	.73	.09
126		.60	.06	.45	.05	1.59	.90	.77	.03
41		.59	.06	.70	.02	1.37	.13	1.07	.02
Mean		.63	.08	.51	.05	1.07	.24	.85	.05
S.D.		.06		.12		.32		.13	
86		.71	.12	.66	.25	1.57	.35	.80	.23
195		.73	.05	.66	.05	1.08	.17	1.07	.07
274		.75	.05	.69	.08	1.20	.18	1.04	.10
283		.82	.12	.66	.08	1.02	.16	.99	.13
211		.64	.15	.57	.07	1.04	.11	.92	.06
115		.70	.05	.70	.10	1.30	.23	1.10	.19
242		.95	.03	.79	.06	1.03	.12	1.13	.05
292		.78	.12	.72	.10	.99	.20	1.11	.09
289		.72	.05	.77	.07	1.30	.23	1.12	.07
Mean		.76	.08	.69	.10	1.17	.19	1.03	.11
S.D.		.09		.07		.19		.11	
291		.73	.05	.61	.02	1.17	.13	.93	.04
247		.63	.04	.60	.04	1.03	.10	.95	.05
254		.72	.08	.53	.04	1.01	.12	.86	.04
57		.74	.03	.64	.02	1.29	.13	.94	.02
198		.78	.08	.76	.12	1.26	.11	1.10	.14
305		.67	.04	.67	.06	1.20	.14	1.02	.07
237		.66	.02	.71	.10	1.35	.18	1.05	.11
Mean		.70	.05	.65	.06	1.19	.13	.98	.07
S.D.		.05		.08		.13		.08	
104		.68	.03	.58	.03	1.03	.08	.91	.02
276		.76	.06	.94	.11	1.55	.15	1.28	.17
102		.61	.06	.65	.12	1.37	.35	1.01	.13
359		.73	.04	.71	.08	1.14	.14	1.06	.10
91		.72	.16	.69	.14	1.06	.18	1.09	.18
306		.69	.03	.66	.05	1.16	.07	1.01	.05
323		.68	.19	.71	.14	1.11	.05	1.07	.03
168		.77	.06	.74	.06	1.04	.12	1.10	.07
154		.71	.05	.71	.03	.99	.27	1.07	.04
Mean		.71	.08	.71	.08	1.16	.16	1.07	.09
S.D.		.05		.10		.18		.10	

LIABILITY

	<u>IC/EP</u>		<u>OSCL/EP</u>		<u>OSCL/PDCL</u>		<u>OSCL + UP/WP</u>	
	MEAN 1971-1976	S.D.	MEAN 1971-1976	S.D.	MEAN 1971-1976	S.D.	MEAN 1971-1976	S.D.
543	.50	.27	1.10	.56	-	-	-	-
55	1.26	.78	3.76	2.25	2.86	.79	-	-
181	1.89	2.08	5.70	2.20	4.55	1.44	6.46	1.41
140	.57	.32	1.51	.39	4.29	1.63	1.82	.43
122	.41	.13	.76	.21	4.22	1.26	1.09	.18
123	.95	.30	1.15	.35	3.16	2.05	1.44	.37
108	.69	.26	1.31	.24	3.44	.73	1.63	.20
274	.79	.19	1.39	.31	3.87	.84	1.64	.29
283	.81	.46	2.00	.66	5.24	2.72	2.18	.59
Mean	.87	.53	2.08	.80	3.95	1.33	2.32	.50
S.D.	.46		1.62		.78		1.85	
58	.40	.05	.80	.15	3.90	.99	1.15	.14
237	.78	.31	1.81	.61	4.12	1.36	2.06	.59
7	.82	.12	.95	.22	2.18	.99	1.39	.51
289	.67	.15	1.60	.29	3.91	1.42	1.94	.25
195	.73	.07	1.51	.06	4.53	1.13	1.77	.06
102	.72	.12	1.61	.12	4.06	.29	1.93	.17
292	.70	.32	1.62	.32	3.36	.95	1.94	.34
Mean	.69	.16	1.41	.25	3.72	1.02	1.74	.29
S.D.	.14		.38		.76		.34	
104	.70	.10	1.16	.16	2.82	.38	1.41	.15
305	.61	.08	1.30	.06	3.53	.43	1.58	.04
115	.90	.25	1.76	.57	4.47	.86	2.03	.52
276	.73	.10	1.71	.21	3.32	.70	2.02	.31
242	1.08	.15	1.85	.30	3.46	.81	1.99	.26
198	.75	.13	1.15	.13	2.73	.45	1.40	.15
306	.62	.05	1.12	.06	3.10	.38	1.44	.06
Mean	.77	.12	1.44	.21	3.35	.57	1.70	.21
S.D.	.17		.32		.58		.30	
168	.82	.19	1.54	.25	2.61	.96	1.82	.22
359	.77	.08	1.83	.14	4.01	.42	2.10	.14
247	.77	.06	1.34	.17	2.61	.28	1.61	.13
91	.81	.11	1.90	.37	3.49	.58	2.28	.43
115	.90	.25	1.76	.57	4.47	.86	2.03	.52
154	.77	.10	1.60	.13	3.15	.51	1.93	.14
323	.79	.20	1.60	.26	3.10	.61	1.96	.15
Mean	.80	.14	1.65	.27	3.35	.60	1.96	.25
S.D.	.05		.19		.70		.21	

Table 13

PROPERTY

	<u>IC/EP</u>		<u>OSCL/EP</u>		<u>OSCL/PDCL</u>		<u>OSCL + UP/VP</u>	
	MEAN 1971-1976	S.D.	MEAN 1971-1976	S.D.	MEAN 1971-1976	S.D.	MEAN 1971-1976	S.D.
114	.45	.18	.44	.10	1.07	.19	.69	.09
140	.66	.08	.59	.62	.68	.44	.93	.37
146	.15	.09	.23	.17	1.22	.66	.61	.19
181	.23	.06	1.63	.45	2.23	.66	1.82	.46
250	.53	.28	.46	.28	1.00	.55	.86	.35
517	.91	.29	.80	.18	1.43	.72	.97	.15
522	.97	.32	1.16	.59	1.55	.86	1.64	.66
56	.53	.14	.24	.07	.54	.26	.69	.05
57	.64	.10	.23	.06	.39	.08	.53	.15
Mean	.56	.17	.64	.28	1.12	.49	.97	.27
S.D.	.27		.48		.57		.46	
183	.23	.06	.04	.02	.17	.08	.47	.02
126	.82	.39	.74	.31	2.00	.79	.93	.28
55	.70	.24	.45	.13	.69	.15	.76	.13
291	.58	.04	.07	.01	.13	.02	.46	.06
195	.79	.37	.72	.32	1.28	.52	1.15	.30
274	.70	.08	.42	.07	.74	.26	.83	.07
53	.62	.13	.48	.12	.93	.25	.79	.10
69	.59	.24	.36	.13	.90	.46	.85	.15
Mean	.63	.19	.41	.14	.86	.32	.78	.14
S.D.	.18		.26		.60		.23	
123	.52	.07	.38	.10	.90	.30	.74	.08
268	.58	.12	.37	.12	.80	.22	.74	.11
254	.67	.03	.43	.03	.70	.06	.76	.04
283	.69	.08	.31	.04	.49	.07	.68	.05
393	.53	.10	.31	.06	.68	.08	.68	.05
402	.41	.11	.16	.09	.44	.15	.57	.08
237	.60	.10	.35	.06	.67	.17	.73	.05
7	.67	.06	.33	.06	.57	.14	.68	.04
115	.53	.19	.55	.07	1.11	.30	.95	.10
Mean	.58	.10	.35	.07	.71	.17	.73	.07
S.D.	.09		.10		.21		.10	
58	.42	.12	.13	.04	.34	.04	.54	.04
108	.48	.07	.16	.01	.37	.03	.56	.05
122	.54	.09	.52	.24	1.42	.94	.89	.23
41	.51	.10	.29	.09	.67	.11	.68	.08
247	.50	.07	.29	.07	.66	.12	.66	.05
391	.42	.02	-	-	-	-	-	-
Mean	.48	.08	.28	.09	.69	.25	.67	.09
S.D.	.05		.15		.44		.14	
305	.54	.09	.29	.04	.62	.14	.69	.06
248	.56	.07	.20	.02	.39	.06	.62	.03
289	.54	.09	.32	.06	.65	.06	.73	.04
292	.50	.05	.44	.07	.98	.21	.86	.07
104	.52	.07	.28	.05	.62	.07	.67	.04
242	.68	.11	.78	.15	1.90	.95	1.16	.15
198	.50	.11	.31	.11	.75	.18	.68	.09
Mean	.53	.08	.37	.07	.84	.24	.77	.07
S.D.	.02		.19		.50		.19	
276	.52	.03	.40	.05	.86	.09	.75	.09
121	.54	.09	.41	.07	.91	.12	.80	.07
306	.53	.08	.29	.06	.64	.06	.71	.03
168	.56	.04	.44	.07	.87	.13	.83	.05
91	.55	.04	.42	.08	.84	.17	.87	.12
359	.53	.07	.33	.07	.71	.14	.68	.05
323	.53	.09	.37	.05	.79	.08	.82	.02
Mean	.54	.06	.38	.06	.80	.11	.78	.06
S.D.	.01		.05		.10		.07	

Factor. Revenue ratio : Incurred Claims/Earned Premiums  
Company Rankings and Differences from Mean.

I. Table 1A.

SMALL	1971		1972		1973		1974		1975		1976		Mean
	Rank	Diff	Rank	Diff	Rank	Diff	Rank	Diff	Rank	Diff	Rank	Diff	Rank
7	23	1	12	12	20	4	23	1	25	1	18	6	24
25	17	16	15	14	1	0	9	8	17	16	7	6	1
41	6	4	9	7	2	0	7	5	13	11	2	0	2
53	25	5	20	0	21	1	24	4	2	18	22	2	20
55	15	7	10	2	8	0	5	3	8	0	3	5	8
56	3	6	7	2	12	3	10	1	14	5	9	0	9
58	12	8	5	1	3	1	12	8	11	7	8	4	4
86	13	3	2	14	10	6	14	2	23	7	24	8	16
108	5	10	21	6	5	10	20	5	5	10	5	10	15
115	18	5	1	12	19	6	4	9	9	4	14	1	13
122	22	0	22	0	13	9	22	0	22	0	15	7	22
123	24	1	25	0	25	0	25	0	24	1	25	0	25
126	10	5	3	2	4	1	3	2	15	10	11	6	5
132	8	4	14	2	18	6	6	6	3	9	16	4	12
140	7	1	16	10	14	8	1	5	4	2	12	6	6
170	4	3	4	3	6	1	13	6	7	0	6	1	7
195	20	2	17	1	16	2	17	1	19	1	19	1	18
211	2	12	18	4	15	1	15	1	1	13	20	6	14
268	19	2	11	6	22	5	18	1	20	3	10	7	17
274	11	8	19	0	17	2	21	2	21	2	23	6	19
283	21	2	23	0	23	0	19	4	18	5	21	2	23
379	1	2	6	3	9	6	16	13	16	13	1	2	3
393	14	4	8	2	11	1	8	2	10	0	4	6	10
402	9	2	13	2	7	4	11	0	6	5	13	2	11
517	16	5	24	3	24	3	2	19	12	9	17	4	21
Rank Corr'n	.665		.621		.800		.631		.396		.772		
MEDIUM													
57	8	2	11	1	8	2	10	0	9	1	12	2	10
102	2	0	1	1	2	0	5	3	3	1	1	1	2
104	5	1	3	3	5	1	6	0	6	0	10	4	6
121	13	6	7	0	6	1	7	0	4	3	9	2	7
198	12	0	8	4	9	3	13	1	12	0	13	1	12
237	1	3	4	0	7	3	2	2	5	1	7	3	4
242	14	0	14	0	14	0	14	0	14	0	14	0	14
247	4	1	5	2	3	0	3	0	2	1	4	1	3
254	6	5	2	1	1	0	1	0	1	0	2	1	1
276	9	2	12	1	11	0	12	1	11	0	8	3	11
289	11	3	9	1	13	5	8	0	7	1	5	3	8
291	10	1	10	1	10	1	9	0	8	1	11	2	9
292	7	6	13	0	12	1	11	2	13	0	3	10	13
305	3	2	6	1	4	1	4	1	10	5	6	1	5
Rank Corr'n	.747		.925		.881		.949		.921		.655		
LARGE													
91	5	1	5	1	6	2	4	0	2	2	2	2	4
154	1	2	2	1	2	1	2	1	6	3	4	1	3
168	6	0	6	0	3	3	3	3	4	2	6	0	6
306	2	0	1	1	1	1	1	1	3	1	5	3	2
323	3	2	4	3	5	4	5	4	1	0	1	0	1
359	4	1	3	2	4	1	6	1	5	0	3	2	5
Rank Corr'n	.614		.543		.129		.300		.486		.529		

	1971		1972		1973		1974		1975		1976		Mean
SMALL	Rank	Diff	Rank	Diff	Rank	Diff	Rank	Diff	Rank	Diff	Rank	Diff	Rank
7	4	3	1	0	4	3	2	1	1	0	1	0	1
25	1	1	3	1	1	1	4	2	2	0	4	2	2
41	21	2	20	1	18	1	17	2	19	0	17	2	19
53	12	0	7	5	12	0	11	1	8	4	18	6	12
55	7	3	9	5	6	2	1	3	3	1	2	2	4
56	2	4	5	1	9	3	7	1	7	1	5	1	6
58	19	5	18	4	13	1	16	2	15	1	12	2	14
86	13	2	11	4	11	4	13	2	20	5	22	7	15
108	3	2	2	3	3	2	14	9	5	0	6	1	5
115	20	0	21	1	21	1	18	2	14	6	13	7	20
122	8	5	4	1	2	1	3	0	4	1	3	0	3
123	16	6	23	1	22	0	23	1	22	0	21	1	22
126	14	7	6	1	5	2	6	1	9	2	8	1	7
140	10	1	12	1	15	4	5	6	12	1	14	3	11
170	9	1	10	0	10	0	10	0	11	1	9	1	10
195	18	2	15	1	17	1	19	3	17	1	16	0	16
211	17	4	17	4	16	3	12	1	10	3	11	2	13
268	22	1	22	1	23	0	22	1	23	0	23	0	23
274	23	5	16	2	14	4	20	2	18	0	19	1	18
283	15	2	19	2	20	3	21	4	16	1	15	2	17
379	5	16	14	7	19	2	15	6	21	0	20	1	21
393	6	2	8	0	7	1	8	0	13	5	10	2	8
402	11	2	13	4	8	1	9	0	6	3	7	2	9
Rank Corr'n	.747		.898		.932		.880		.942		.919		
MEDIUM													
57	9	4	6	1	5	0	5	1	5	0	5	0	5
102	2	4	2	4	2	4	7	1	7	1	8	2	6
104	3	1	3	1	3	1	3	1	4	2	3	1	2
121	13	0	13	0	12	1	11	2	10	3	9	4	13
198	10	0	5	5	9	1	13	3	12	2	13	3	10
237	7	1	4	4	8	0	8	0	8	0	10	2	8
242	11	1	12	0	11	1	12	0	13	1	11	1	12
247	5	2	8	5	6	3	4	1	1	2	1	2	3
254	1	0	1	0	1	0	1	0	2	1	2	1	1
276	14	0	14	0	14	0	14	0	14	0	14	0	14
289	12	1	10	1	13	2	10	1	9	2	12	1	11
291	8	4	9	5	4	0	2	2	3	1	4	0	4
292	4	5	11	2	10	1	9	0	11	2	7	2	9
305	6	1	7	0	7	0	6	1	6	1	6	1	7
Rank Corr'n	.815		.749		.938		.952		.930		.897		
LARGE													
91	2	0	4	2	5	3	4	2	2	0	2	0	2
154	3	0	3	0	3	0	1	2	5	2	4	1	3
168	5	1	6	0	4	2	6	0	4	2	5	1	6
306	1	0	1	0	1	0	2	1	3	2	3	2	1
323	6	2	5	1	6	2	5	1	1	3	1	3	4
359	4	1	2	3	2	3	3	2	6	1	6	1	5
Rank Corr'n	.857		.714		.342		.629		.371		.486		



	1971		1972		1973		1974		1975		1976		Mean
	Rank	Diff	Rank	Diff	Rank	Diff	Rank	Diff	Rank	Diff	Rank	Diff	Rank
SMALL													
7	2	1	1	0	2	1	1	0	1	0	1	0	1
25	1	2	4	1	4	1	5	2	2	1	5	2	3
41	18	1	18	1	19	0	21	2	19	0	19	0	19
53	4	1	5	0	10	5	4	1	7	2	10	5	5
55	6	2	10	6	5	1	3	1	4	0	2	2	4
56	9	3	7	1	9	3	7	1	5	1	4	2	6
58	16	1	15	0	11	4	16	1	17	2	12	3	15
86	15	5	20	0	21	1	20	0	20	0	21	1	20
108	5	11	2	14	3	13	18	2	22	6	16	0	16
115	20	2	21	3	17	1	19	1	12	6	13	5	18
122	3	1	3	1	1	1	2	0	3	1	3	1	2
126	22	1	19	2	18	3	15	6	15	6	9	12	21
140	8	1	8	1	16	7	8	1	10	1	18	9	9
170	13	3	13	3	8	2	13	3	14	4	8	2	10
195	14	1	9	4	14	1	17	4	16	3	15	2	13
211	17	5	16	4	13	1	11	1	11	1	6	6	12
268	19	3	22	0	22	0	22	0	21	1	22	0	22
274	21	4	11	6	15	2	14	3	18	1	20	3	17
283	11	0	14	3	12	1	12	1	9	2	14	3	11
379	10	4	17	3	20	6	10	4	8	6	17	3	14
393	7	0	6	1	6	1	6	1	13	6	11	4	7
402	12	4	12	4	7	1	9	1	6	2	7	1	8
Rank Corr'n	.843		.792		.816		.929		.877		.790		
MEDIUM													
57	14	5	9	0	12	3	7	2	7	2	11	2	9
102	6	7	5	8	8	5	13	0	14	1	14	1	13
104	5	2	6	3	4	1	3	0	2	1	3	0	3
121	11	0	13	2	6	5	9	2	12	1	9	2	11
198	10	2	12	4	10	2	12	4	8	0	7	1	8
237	8	4	10	2	13	1	11	1	13	1	10	2	12
242	2	2	3	1	1	3	5	1	5	1	4	0	4
247	4	1	7	2	5	0	4	1	1	4	2	3	5
254	3	1	1	1	2	0	2	0	4	2	5	3	2
276	13	1	14	0	14	0	14	0	10	4	12	2	14
289	9	1	2	8	11	1	10	0	11	1	13	3	10
291	12	6	8	2	3	3	6	0	3	3	8	2	6
292	1	0	4	3	7	6	1	0	6	5	1	0	1
305	7	0	11	4	9	2	8	1	9	2	6	1	7
Rank Corr'n	.712		.591		.728		.936		.831		.906		
LARGE													
91	2	0	3	1	6	4	3	1	1	1	3	1	2
154	5	0	5	0	3	2	4	1	4	1	5	0	5
168	1	0	6	5	1	0	1	0	2	1	1	0	1
306	4	2	4	2	5	1	6	0	5	1	4	2	6
323	6	3	2	1	4	1	2	1	3	0	2	1	3
359	3	1	1	3	2	2	5	1	6	2	6	2	4
Rank Corr'n	.600		.143		.257		.814		.771		.671		

Motor.. Revenue ratio : (Outstanding Claims +  
Unearned Premiums)/Written Premiums  
Company Rankings and Differences from Mean.

I. Table 4A

	1971		1972		1973		1974		1975		1976		Mean
SMALL	Rank	Diff	Rank	Diff	Rank	Diff	Rank	Diff	Rank	Diff	Rank	Diff	Rank
7	6	5	2	1	1	0	1	0	1	0	1	0	1
25	2	1	6	3	5	2	8	5	3	0	4	1	3
41	21	3	20	2	17	1	16	2	19	1	17	1	18
53	10	1	7	2	11	2	10	1	6	3	13	4	9
55	7	3	11	7	9	5	3	1	4	0	2	2	4
56	4	1	3	2	10	5	6	1	8	3	5	0	5
58	18	3	19	4	16	1	15	0	13	2	14	1	15
86	5	2	1	6	3	4	2	5	12	5	20	13	7
108	16	4	4	8	4	8	14	2	7	5	18	6	12
115	19	1	22	2	20	0	18	2	14	6	15	5	20
122	8	6	5	3	2	0	5	3	2	0	3	1	2
126	12	6	8	2	6	0	4	2	5	1	6	0	6
140	11	2	13	0	14	1	7	6	15	2	11	2	13
170	13	2	10	1	12	1	11	0	10	1	9	2	11
195	20	1	18	1	18	1	21	2	20	1	16	3	19
211	15	1	14	0	13	1	13	1	16	2	10	4	14
268	22	0	21	1	22	0	22	0	22	0	22	0	22
274	17	0	15	2	15	2	20	3	17	0	19	2	17
283	14	2	16	0	19	3	19	3	18	2	12	4	16
379	1	20	17	4	21	0	17	4	21	0	21	0	21
393	3	5	9	1	7	1	9	1	11	3	7	1	8
402	9	1	12	2	8	2	12	2	9	1	8	2	10
Rank Corr'n	.687		.866		.907		.903		.920		.837		
MEDIUM													
57	7	3	5	1	5	1	4	0	5	1	4	0	4
102	4	2	2	4	3	3	7	1	7	1	7	1	6
104	2	0	3	1	2	0	3	1	2	0	5	3	2
121	14	1	13	0	13	0	13	0	13	0	10	3	13
198	8	1	6	3	9	0	12	3	11	2	13	4	9
237	6	2	4	4	7	1	8	0	8	0	8	0	8
242	11	1	12	0	11	1	11	1	9	3	9	3	12
247	5	0	9	4	6	1	5	0	1	4	1	4	5
254	1	0	1	0	1	0	1	0	4	3	2	1	1
276	12	2	14	0	14	0	14	0	14	0	14	0	14
289	13	2	11	0	12	1	9	2	12	1	11	0	11
291	9	6	7	4	4	1	2	1	3	0	3	0	3
292	10	0	10	0	10	0	10	0	10	0	12	2	10
305	3	4	8	1	8	1	6	1	6	1	6	1	7
Rank Corr'n	.804		.833		.965		.958		.899		.862		
LARGE													
91	2	3	5	0	6	1	6	1	1	4	6	1	5
154	5	2	3	0	3	0	1	2	3	0	4	1	3
168	3	3	6	0	5	1	5	1	5	1	3	3	6
306	1	0	2	1	2	1	3	2	2	1	1	0	1
323	6	2	4	0	4	0	4	0	4	0	2	2	4
359	4	2	1	1	1	1	2	0	6	4	5	3	2
Rank Corr'n	.286		.943		.886		.714		.029		.400		

1979 DOT Annual Returns Working Party

The use of incurred loss ratios

Author: G. C. Orros

1. Introduction

1.1 This paper considers the use of the incurred loss ratios derived from the Department of Trade (DOT) Annual Returns, as specified in S.I.1968 No. 1408. These loss ratios can be calculated from either the General Business Revenue Accounts (Schedule 2, Part III), or from the claims frequency and settlement analyses (Schedule 3, Parts II and III). This paper considers both possibilities. Consideration is also given to the difference between the original and subsequent estimates of incurred loss ratios.

1.2 An attempt has been made to measure the coefficients of correlation between years of business and between classes of business. Separate results have been prepared from the General Business Revenue Accounts and from the claims frequency and settlement analyses. For the latter a distinction has been made between the first Year of Account and the latest year of account, which allows for the benefit of hindsight.

1.3 An attempt has also been made to measure the statistical variations between one year and the next. The loss ratios of the latest cohort have been expressed in terms of the number of standard deviations from the observed past average loss ratios. This approach may indicate, in terms of numbers of standard deviations, the margin (or deficit) inherent in the current underwriting results. It is also possible to express the free capital in terms of the number of standard deviations of the observed past average loss ratios. Consequently, one can begin to measure the number of times that the free capital covers the technical provisions, including margins.

1.4 This paper is based on the past DOT Annual Returns of 11 major U.K. general insurance companies. Consideration has been limited to up to 4 risk groups. These were Motor, Property and Liability for the General Business Revenue Accounts. The claims frequency and settlement analyses were restricted to Private cars, Fire, Personal accident and Employers liability. In order to clarify matters (as well as for ease of computation) the majority of this paper makes the unlikely assumption of equal weights for each risk group. Nevertheless, it is hoped that this major simplifying assumption may enable the reader to see the wood instead of the trees.

1.5 For reasons of confidentiality the 11 general insurance companies have been labelled A to K. Although the DOT Annual Returns represent public information, it was felt that the major simplifying assumption (of equal weights for each risk group) may have distorted the apparent underwriting performance of some companies. Furthermore, the Schedule 3 statistics are recorded gross of reinsurance recoveries, which can sometimes disguise the true underwriting performance and thereby give a misleading impression.

## 2. Data and Definitions

The data analysed for this paper was taken from the past DOT Annual Returns for 11 major U.K. insurance companies.

2.1 This paper considers 3 separate measures of the loss ratio. In order to avoid confusion this paper defines these 3 measures as "adjusted incurred loss ratios", "unadjusted incurred loss ratios" and "Revenue Account loss ratios". The terminology is defined in paragraphs 2.2 to 2.5.

2.2 The incurred loss ratio relates to a specific year of origin (year of accident). The numerator is the claims incurred (including outstanding claim estimates) in the specific year of origin. The denominator is the earned premiums allocated to the year of origin. The earned premiums represent an allocation of the written premiums to the period exposed to risk. The amounts recorded on Schedule 3 are calculated gross of reinsurance recoveries.

2.3 The "adjusted incurred loss ratios" were based on the Schedule 3, Parts II and III, U.K. Returns for years of origin 1972 to 1976 and for years of account 1972 to 1977. The earned premiums were taken as Item A(c) of Schedule 3, Part II, Form No. 100. The incurred losses were taken from Schedule 3, Part III, Form No. 300, as revised up to the 1977 year of account. In other words, allowance was made for claims payments up to the 1977 year of account and for outstanding claims estimates at that date.

2.4 The "unadjusted incurred loss ratios" were based on the Schedule 3, Parts II and III, U.K. Returns for years of origin 1972 to 1977 and for years of account 1972 to 1977. The incurred losses from Schedule 3, Part III, were taken from the first year of account for each year of origin.

2.5 The "Revenue Account loss ratios" were based on Schedule 2, Part III, Returns for years of account 1971 to 1976. The numerator is the claims for the year of account, which were based on items 3, 11 and 18 of Schedule 2, Part III and, therefore, relates to a mix of years of origin. The denominator is the earned premiums, which were largely based on items 1, 6 and 16 of Schedule 2, Part III. For some companies the Revenue Account loss ratios referred to worldwide (rather than U.K.) insurance business. In some cases the domestication of business for some years of account has clearly distorted the reported Schedule 2 loss ratios. Distortions have also arisen from changes in accounting policy from one year of account to the next.

2.6 This paper also makes a number of references to coefficients of correlation. These have been measured between the risk group under consideration and the mean for all risk groups combined. The summary tables of coefficients of correlation (i.e. Tables 4 to 9) were all based on the Data Appendix (i.e. Tables 18 to 28). For example, consider the first item on Table 4. This refers to the Company A adjusted incurred loss ratio coefficients of correlation for 1972 incurred claims. The correlation coefficient of .986 has been measured from the top part of Table 18, by considering the correlation between the 4 separate 1972 incurred loss ratios (i.e. .72, .34, .56 and .77) against the corresponding loss ratios for the mean of all years incurred (i.e. .658, .483, .616 and .711). The high correlation coefficient of .986 indicates a high positive correlation between the 1972 incurred and the mean of 1972 to 1976 incurred adjusted incurred loss ratios for Company A.

### 3. Conclusions

3.1 The main conclusion was considered to be that the incurred loss ratios derived from Schedule 3, Parts II and III, were more useful than those derived from Schedule 2, Part III.

3.2 The incurred loss ratios from Schedule 3 varied widely between companies. The smallest variations were for Private cars and Fire and the largest were for Employers liability. The original estimates supplied for the first Year of Account included margins or deficits, which were released in subsequent Years of Account as the claim payments emerged. These releases have been measured with the benefit of hindsight and may not have necessarily been deliberate; they were probably influenced by anticipated future inflation rates, which perhaps did not materialise.

3.3 Various schedules of coefficients of correlation were prepared. The Schedule 3 incurred loss ratios of the 4 risk groups were highly positively correlated between different cohort periods. The adjusted incurred loss ratios were more highly correlated than the unadjusted incurred loss ratios (perhaps due to the varying margins inherent in the unadjusted incurred loss ratios). The correlation coefficients were high for some companies (e.g. Company C) and low for others (e.g. Company I). The Schedule 2 correlation coefficients between accounting years were not particularly close to those for Schedule 3 between cohort periods.

3.4 The Schedule 3 correlation coefficients between risk groups seemed to be quite revealing. The adjusted incurred loss ratios for Private cars seemed to be negatively correlated with the other risk groups. The correlations between risk groups were considerably lower than the correlations between years of business. The Schedule 2 correlation coefficients between risk groups seemed to be higher than those for Schedule 3. The Revenue Account loss ratios for Motor were positively correlated with the Property and Liability risk groups. It should be appreciated, however, that the Schedule 3 Returns were mostly U.K. only and were a subset of the Schedule 2 Returns, which were sometimes worldwide. The Motor risk group was larger and had a wider spread of risks than the Private cars risk group.

3.5 Various attempts were made to measure the margin inherent in the unadjusted incurred loss ratios, in terms of the number of standard deviations of the mean. If one treated the overall loss ratios (with equal weights for each risk group) as random variables then the margin seemed to be (on average) between 1 and 2 standard deviations of the mean overall loss ratios. The assumptions underlying this simple approach were, however, considered to be somewhat unrealistic.

3.6 The next stage was to assume that the past adjusted incurred loss ratios for each of the 4 risk groups each represented random variables. It was again assumed that the 4 risk groups had equal weights. The standard deviations of the overall loss ratios were calculated as the root mean square of standard deviations of the 4 risk groups. The margin inherent in the unadjusted incurred loss ratios appeared to be (on average) less than 1 standard deviation of the mean.

3.7 The final stage was to remove the major simplifying assumption of equal weights for each risk group. The means and standard deviations were weighted in accordance with the earned premiums for the cohort under consideration. The standard deviations were calculated as the weighted root mean square of the 4 risk groups, the weights being the earned premiums for the latest cohort (for which only unadjusted results were available). In general the weighted mean incurred loss ratios were slightly lower than the unweighted mean incurred loss ratios, which was not unexpected. The weighted standard deviations were, however, substantially lower than the unweighted standard deviations. This feature resulted in the margin inherent in the weighted unadjusted incurred loss ratios being higher (in terms of number of standard deviations) than for the unweighted case.

#### 4. Further developments and research

It is considered that one or two of the concepts underlying this paper may be worth pursuing in the near future. A brief description of these ideas is set out below.

4.1 The Schedule 3 incurred loss ratio statistics could be extended to all risk groups. This would enable an overall view to be taken of the underwriting results of the 11 companies. It would be revealing to tabulate the average past means and standard deviations of the loss ratios for all risk groups both in isolation and aggregated.

4.2 The project could be extended to smaller general insurance companies. It would be interesting to tabulate the means and standard deviations according to the size range of the companies. One would expect to find larger variations with smaller companies and this may have solvency implications.

4.3 The concept of using incurred loss ratios to measure margins and variability could be extended to outstanding claim provisions and perhaps earned premium provisions. In other words, one could try to quantify the margins inherent in the technical provisions, both in monetary terms and in terms of numbers of standard deviations. The free capital could also be measured in similar terms. One could then measure the extent to which the solvency margin (including margins) covers likely variations in incurred loss ratios within the company. Perhaps this could even lead to a solvency criterion. The aim might be to produce the following kind of statement (using hypothetical figures) at regular intervals:-

	<u>£million</u>	<u>Number of standard deviations</u>
(i) Company's actual technical provisions	55.7	
(ii) Expected technical provisions	46.4	
(iii) Standard deviation	5.1	
(iv) Margin in technical provisions, (i)-(ii)	9.3	1.8
(v) Company's free capital	23.2	4.6
(vi) Total solvency margin, (iv) + (v)	32.5	6.4

## 5. Summary of Results

The main results of this paper have been presented via Tables 1 to 17 and the Data Appendix (Tables 18 to 28).

5.1 The detailed loss ratios for each of the 11 companies can be found in the Data Appendix (Tables 18 to 28) at the end of this paper. Separate tabulations have been prepared for the "adjusted incurred loss ratios", the "unadjusted incurred loss ratios" and the "Revenue Account loss ratios". The statistics calculated for each tabulation assume equal weights for each risk group.

5.2 The coefficients of correlation in the Data Appendix were measured between the risk group under consideration and the mean for all risk groups combined. For example, consider the adjusted incurred loss ratios part of Table 18. Consider the correlation between the private cars risk group and the mean of the 4 risk groups; namely, between

	.72	.67	.65	.64	.61
and	.598	.628	.658	.600	.608

The coefficient of correlation is  $-.155$ , which indicates that (for Company A) private cars were negatively correlated with the mean of the 4 risk groups.

5.3 Table 1 summarises the average adjusted incurred loss ratios for cohorts 1972 to 1976. The Fire risk group seems to have attracted the lowest loss ratios and Employers liability the highest. The overall coefficients of variation between companies range from 8% for Private cars to 36% for Employers liability.

5.4 Table 2 summarises the average unadjusted incurred loss ratios for cohorts 1972 to 1977. The Personal accident risk group seems to have attracted the lowest loss ratios and Employers liability the highest. The overall coefficients of variation between companies range from 8% for Private cars to 41% for Employers liability. A comparison of Tables 1 and 2 indicates the extent of margins in unadjusted incurred loss ratios (excluding the effect of the 1977 cohort).

5.5 Table 3 summarises Revenue Account loss ratios for years of account 1971 to 1976. These risk groups cover a higher volume of premium income and a wider spread of risk than Tables 1 and 2, as well as involving a mix of cohort periods and territories. The overall coefficients of variation between companies range from 6% for Property to 19% for Liability.

5.6 Tables 4, 5 and 6 summarise the coefficients of correlation between years of business for all 11 companies. Table 4 refers to the adjusted incurred loss ratios and indicates high positive correlations, except perhaps for the 1976 cohort. Table 5 refers to the unadjusted incurred loss ratios. These do not seem to be as highly correlated as in Table 4. Table 6 refers to the Revenue Account loss ratios. These indicate high positive correlations, except perhaps for the 1976 year of account. In fact, 1976 appears to have the lowest correlations in each of Tables 4, 5 and 6.

5.7 Tables 7, 8 and 9 summarise the coefficients of correlation between classes of business for all 11 companies. Table 7 refers to the adjusted incurred loss ratios. This indicates that Private cars are negatively correlated with the mean of Private cars, Fire, Personal accident and Employers liability. In general, the correlations were not as high between classes as between years of business (see Table 4). The standard deviations of the 11 samples were higher than for Table 4. Table 8 refers to the unadjusted incurred loss ratios. These correlations were also not as high as between years of business (see Table 5). Table 9 refers to the Revenue Account loss ratios. These correlations between classes of business were in general only slightly lower than between years of business (see Table 6).

- 5.8 Table 10 attempts to measure the margin in the average loss ratios for the unadjusted 1976 cohort. The base used was the adjusted 1972 to 1975 incurred loss ratios. The mean adjusted loss ratios for the 1972 to 1975 cohorts were taken to be random variables. This assumption was considered to be unrealistic, in view of the observed heterogeneity between the 4 risk groups.
- 5.9 Table 11 attempts to measure the margin in the average loss ratios for the unadjusted 1977 cohort. The base used was the adjusted 1972 to 1976 incurred loss ratios. Similar remarks apply as for Table 10.
- 5.10 Table 12 attempts to refine the calculation of the standard deviations of incurred loss ratios. It is still assumed that each risk attracts equal weight. The standard deviations are calculated as the root mean square of the 4 samples for each company. This approach might be interpreted as reflecting the additivity of variances, together with the assumed equal weights for each risk group.
- 5.11 Tables 13 and 14 are similar to Tables 10 and 11, but also make use of the standard deviations from Table 12. The underlying assumptions were considered to be more realistic than for Tables 10 and 11. The margin in the incurred loss ratios for the latest unadjusted cohort appeared to be less than one standard deviation from the mean of the past adjusted incurred loss ratios.
- 5.12 Table 15 summarises the 1976 and 1977 earned premium distributions for all 11 companies. Company D seems to concentrate on Private cars and Company G on Fire. Company H seems to have devoted its attention towards Employers liability.
- 5.13 Tables 16 and 17 are similar to Tables 13 and 14, but also make use of the earned premium distributions from Table 15. The resulting approach was considered to be the most realistic in determining the margins inherent in the overall unadjusted incurred loss ratios.
- 5.14 The Data Appendix consists of Tables 18 to 28, which contain the detailed loss ratios for each of the 11 companies. The statistics calculated for each tabulation assume equal weights for each risk group. In practice, however, this assumption is not satisfied (as can be seen from Table 15). Nevertheless, it is hoped that this major simplifying assumption may facilitate inter company comparisons.



TABLE 1Adjusted incurred loss ratios (mean of 1972 to 1976)

Company	Private cars	Fire	Personal accident	Employers liability	Average result
A	.658	.483	.616	.711	.617
B	.676	.534	.452	1.764	.857
C	.590	.516	.437	.864	.602
D	.673	.543	.524	.868	.652
E	.653	.511	.493	.885	.636
F	.615	.502	.433	.743	.573
G	.684	.499	.624	.820	.657
H	.613	.576	.693	.846	.682
I	.563	.484	.550	.602	.550
J	.544	.474	.456	.618	.523
K	.682	.397	.839	1.025	.736
Mean	.632	.502	.556	.886	.644
Standard deviation	.050	.046	.127	.316	.135
Coefficient of variation	.079	.091	.229	.357	.189

Notes

1. The above table summarises the column "mean" from Tables 18 to 28 for all 11 companies. The "average result" is the arithmetic mean of the 4 risk groups.
2. Allowance has been made for claim payments up to the 1977 Year of Account and outstanding claims estimates at that date.

TABLE 2Unadjusted incurred loss ratios (mean of 1972 to 1977)

Company	Private cars	Fire	Personal accident	Employers liability	Average result
A	.675	.580	.611	.711	.644
B	.755	.548	.491	1.835	.907
C	.674	.597	.440	1.092	.701
D	.724	.645	.550	.871	.698
E	.665	.640	.464	.930	.675
F	.623	.546	.434	.608	.553
G	.663	.543	.592	.669	.617
H	.650	.646	.669	.813	.695
I	.592	.581	.550	.571	.574
J	.583	.512	.469	.607	.543
K	.648	.467	.753	.860	.682
Mean	.659	.573	.548	.870	.663
Standard deviation	.051	.057	.102	.358	.142
Coefficient of variation	.077	.100	.186	.411	.194

Notes

1. The above table summarises the column "mean" from Tables 18 to 28 for all 11 companies. The "average result" is the arithmetic mean of the 4 risk groups.
2. The above results were based on the original estimates submitted via the Schedule 3 Returns.

TABLE 3Revenue account loss ratios (mean of 1971 to 1976)

Company	Motor	Property	Liability	Average result
A	.760	.518	.730	.669
B	.717	.553	.813	.694
C	.683	.527	.790	.667
D	.708	.600	.765	.691
E	.765	.557	.818	.713
F	.730	.525	.770	.675
G	.780	.500	.705	.662
H	.700	.535	1.198	.811
I	.687	.528	.617	.611
J	.607	.490	.722	.606
K	.780	.500	.747	.676
Mean	.720	.530	.789	.680
Standard deviation	.052	.031	.147	.077
Coefficient of variation	.072	.059	.186	.106

Notes

1. The above table summarises the column "mean" from Tables 18 to 28 for all 11 companies. The "average result" is the arithmetic mean of the 3 risk groups.
2. The above results were based on the Schedule 2, Part III Returns.

TABLE 4

Correlation coefficients between years of business  
Adjusted incurred loss ratios

Company	1972 incurred	1973 incurred	1974 incurred	1975 incurred	1976 incurred
A	.986	.913	.639	.993	.261
B	.989	.998	.997	.900	.562
C	.923	.988	.980	.999	.984
D	.947	.879	.921	.958	.982
E	.955	.992	.991	.992	.947
F	.890	.962	.966	.976	.338
G	.998	.919	.964	.548	.184
H	.977	.955	.993	.864	.469
I	.945	.943	.238	.196	.802
J	.984	.812	.970	.934	.213
K	.825	.735	.914	.815	.519
Mean	.947	.918	.870	.834	.569
Standard deviation	.052	.082	.233	.248	.312

Notes

1. The above table summarises the row "coefficient of correlation" from Tables 18 to 28 for all 11 companies. The correlations were measured against the mean for cohorts 1972 to 1976.

TABLE 5

Correlation coefficients between years of business  
Unadjusted incurred loss ratios

Company	1972 incurred	1973 incurred	1974 incurred	1975 incurred	1976 incurred	1977 incurred
A	.869	.664	.678	.988	- .287	.713
B	.994	.996	.993	.877	.934	.887
C	.972	.991	.986	.996	1.000	.971
D	.943	.981	.706	.953	.980	.968
E	.971	.999	.992	.969	.980	.995
F	.774	.967	.940	.929	.522	.967
G	.108	.856	.658	.999	- .018	.543
H	.983	.881	.935	.611	.509	.906
I	.201	.025	.541	- .891	.154	.760
J	.921	.768	.890	.996	.274	.933
K	.542	.485	.809	.807	.895	.570
Mean	.753	.783	.830	.749	.540	.838
Standard deviation	.324	.300	.160	.556	.458	.165

Notes

1. The above table summarises the row "coefficients of correlation" from Tables 18 to 28 for all 11 companies. The correlations were measured against the mean for cohorts 1972 to 1977.

TABLE 6

Correlation coefficients between years of business  
Revenue Account loss ratios

Company	1971 account	1972 account	1973 account	1974 account	1975 account	1976 account
A	.970	.999	.967	.990	.999	.840
B	.894	.999	.998	.947	.446	.965
C	.998	.993	1.000	.992	.953	.083
D	.940	.986	.998	.880	.984	.940
E	.801	.963	.954	.995	.736	.987
F	1.000	.993	.967	.964	.931	.688
G	1.000	1.000	.828	.790	.998	.118
H	.988	- .559	1.000	.995	.990	.971
I	.987	.986	.917	.726	.869	.898
J	.999	.999	1.000	.869	.962	- .448
K	.996	.994	.975	.964	1.000	.108
Mean	.961	.850	.964	.919	.897	.559
Standard deviation	.063	.468	.052	.092	.169	.501

Notes

1. The above table summarises the row "coefficients of correlation" from Tables 18 to 28 for all 11 companies. The correlations were measured against the mean for Years of Account 1971 to 1976.

TABLE 7

Correlation coefficients between classes of business  
Adjusted incurred loss ratios

Company	Private cars	Fire	Personal accident	Employers Liability
A	- .155	.919	- .122	.172
B	- .692	- .140	- .035	.938
C	.091	.945	.013	.848
D	- .526	.763	.964	.889
E	.051	.932	.653	.949
F	.248	.674	.446	- .013
G	- .211	.467	- .093	.694
H	- .224	.266	.500	.923
I	- .444	.980	.360	.804
J	- .472	.883	.783	.646
K	.816	.396	.823	- .296
Mean	- .138	.644	.390	.596
Standard deviation	.427	.358	.397	.436

Notes

1. The above table summarises the column "coefficient of correlation" from Tables 18 to 28 for all 11 companies. The correlations were measured against the mean for all risk groups.

TABLE 8

Correlation coefficients between classes of business  
Unadjusted incurred loss ratios

Company	Private cars	Fire	Personal accident	Employers Liability
A	.138	.656	.263	.518
B	- .345	.087	.551	.994
C	- .368	.584	.346	.895
D	.434	.773	.877	.833
E	.126	.936	.643	.951
F	.332	.817	.291	.662
G	.170	.747	.744	.590
H	.208	.923	.280	.629
I	- .660	.887	.685	.186
J	.566	.969	.944	.723
K	.730	.091	.766	.628
Mean	.121	.679	.581	.692
Standard deviation	.423	.315	.250	.229

Notes

1. The above table summarises the column "coefficient of correlation" for all 11 companies. The correlations were measured against the mean for all risk groups.



TABLE 9

Correlation coefficient between classes of business  
Revenue Account loss ratios

Company	Motor	Property	Liability
A	.922	.561	.982
B	.963	.487	.845
C	.992	.943	.988
D	.947	.851	.971
E	.850	.605	.976
F	.103	.262	.854
G	.877	.954	.990
H	.014	.320	.976
I	.288	.897	.401
J	.838	- .055	.638
K	.946	.601	.724
Mean	.704	.584	.850
Standard deviation	.373	.321	.191

Notes

1. The above table summarises the column "coefficient of correlation" for all 11 companies. The correlations were measured against the mean for all risk groups.

TABLE 10

Margin in average loss ratios for the 1976 cohort  
Based on adjusted 1972 to 1975 incurred loss ratios

Company	Mean 1972-1975	SD of mean 1972-1975	Mean 1976	Margin (no. of SD's)
A	.621	.028	.645	.9
B	.878	.191	.708	- .9
C	.596	.039	.698	2.6
D	.641	.086	.735	1.1
E	.619	.012	.723	8.7
F	.565	.041	.603	.9
G	.658	.048	.673	.3
H	.681	.041	.745	1.6
I	.547	.053	.605	1.1
J	.510	.034	.613	3.0
K	.704	.063	.710	.1
Mean of x	.638	.058	.678	1.8
SD of x				2.5
Mean of  x				1.9
SD of  x				2.4

Notes

1. The "SD of mean 1972-1975" was based on the row "mean" for adjusted cohorts 1972 to 1975 in Tables 18 to 28. The "mean 1976" refers to the unadjusted 1976 incurred mean.
2. The "margin (no. of SD's)" is given by

$$\frac{\text{"Mean 1976" less "Mean 1972-1975"}}{\text{"SD of mean 1972-1975"}}$$

TABLE 11

Margin in average loss ratios for the 1977 cohort  
Based on adjusted 1972 to 1976 incurred loss ratios

Company	Mean 1972-1976	SD of mean 1972-1976	Mean 1977	Margin (no. of SD's)
A	.617	.025	.665	1.9
B	.857	.172	.745	- .7
C	.602	.036	.673	2.0
D	.652	.078	.720	.9
E	.636	.040	.728	2.3
F	.573	.040	.580	.2
G	.657	.042	.703	1.1
H	.682	.036	.718	1.0
I	.550	.046	.545	- .1
J	.523	.041	.578	1.3
K	.736	.091	.840	1.1
Mean of x	.644	.059	.681	1.0
SD of x				0.9
Mean of  x				1.1
SD of  x				0.7

Notes

1. The "SD of mean 1972-1976" was based on the row "mean" for adjusted cohorts 1972 to 1976 in Tables 18 to 28. The "mean 1977" refers to the unadjusted 1977 incurred mean.
2. The "margin (no. of SD's)" is given by

$$\frac{\text{"Mean 1977" less "Mean 1972-1976"}}{\text{"SD of mean 1972-1975"}}$$

TABLE 12

Standard deviations of adjusted incurred loss ratios

Company	Private cars	Fire	Personal accident	Employers liability	SD of mean	SD overall (equal weights)
<u>1972 to 1975</u>	%	%	%	%	%	%
A	3.6	12.7	1.8	1.3	2.8	6.7
B	3.9	9.2	3.1	76.6	19.1	38.7
C	1.7	7.3	3.3	10.8	3.9	6.8
D	1.3	11.0	9.6	19.8	8.6	12.3
E	4.1	5.8	2.4	2.9	1.2	4.0
F	4.9	8.2	6.7	9.4	4.1	7.5
G	4.5	7.8	8.3	18.9	4.8	11.3
H	1.8	2.9	6.9	9.5	4.1	6.1
I	1.0	13.4	3.9	9.4	5.3	8.4
J	3.3	6.0	4.7	6.8	3.4	5.4
K	1.7	7.7	24.1	23.1	6.3	17.2
<u>1972 to 1976</u>						
A	3.9	9.7	7.6	8.0	2.5	7.6
B	5.2	20.6	3.0	72.6	17.2	37.9
C	3.9	6.0	2.7	8.3	3.6	5.6
D	0.7	9.4	8.1	15.6	7.8	10.0
E	3.2	8.6	2.4	4.7	4.0	5.3
F	3.7	16.3	5.7	8.9	4.0	9.9
G	3.8	10.2	6.4	16.5	4.2	10.4
H	1.5	9.7	7.9	7.3	3.6	7.3
I	1.7	10.4	3.3	7.2	4.6	6.6
J	3.0	10.5	4.1	5.4	4.1	6.4
K	3.9	6.0	41.2	22.6	9.1	23.8

Notes

1. The "SD overall (equal weights)" is based on the 4 risk groups and assume they have equal weight. The formula is

$$\left( \frac{\sum x^2}{4} \right)^{\frac{1}{2}}$$

TABLE 13

Margin in average loss ratios for the 1976 cohort  
Based on adjusted 1972 to 1975 incurred loss ratios

Company	Mean 1972-1975	SD overall (equal weights) 1972-1975	Mean 1976	Margin (no. of SD's)
A	.621	.067	.645	.4
B	.878	.387	.708	- .4
C	.596	.068	.698	1.5
D	.641	.123	.735	.8
E	.619	.040	.723	2.6
F	.565	.075	.603	.5
G	.658	.113	.673	.1
H	.681	.061	.745	1.0
I	.547	.084	.605	.7
J	.510	.054	.613	1.9
K	.704	.172	.710	.03
Mean of x	.638	.113	.678	0.8
SD of x				0.9
Mean of  x				0.9
SD of  x				0.8

Notes

1. The above table was based on Tables 10 and 12.

TABLE 14

Margin in average loss ratios for the 1977 cohort  
Based on adjusted 1972 to 1976 incurred loss ratios

Company	Mean 1972-1976	SD overall (equal weights) 1972-1976	Mean 1977	Margin (no. of SD's)
A	.617	.076	.665	.6
B	.857	.379	.745	- .3
C	.602	.056	.673	1.3
D	.652	.100	.720	.7
E	.636	.053	.728	1.7
F	.573	.099	.580	.1
G	.657	.104	.703	.4
H	.682	.073	.718	.5
I	.550	.066	.545	- .1
J	.523	.064	.578	.9
K	.736	.238	.840	.4
Mean of x	.644	.119	.681	0.6
SD of x				0.6
Mean of  x				0.6
SD of  x				0.5

Notes

1. The above table was based on Tables 11 and 12.

TABLE 15

Earned premiums distribution for 1976 and 1977

	Private cars	Fire	Personal accident	Employers liability	Overall
<u>1976 earned premiums</u>	%	%	%	%	%
A	37.2	48.3	7.9	6.6	100
B	33.3	48.5	5.6	12.6	100
C	33.9	52.5	7.2	6.4	100
D	64.3	28.0	3.1	4.6	100
E	49.4	42.0	1.8	6.8	100
F	19.0	67.8	8.2	5.0	100
G	20.8	68.5	2.5	8.2	100
H	30.8	38.3	1.1	29.8	100
I	56.7	34.9	4.7	3.7	100
J	55.4	41.4	1.1	2.1	100
K	39.6	50.7	2.1	7.6	100
<u>1977 earned premiums</u>					
A	36.6	47.4	9.9	6.1	100
B	34.8	50.1	5.4	9.7	100
C	37.4	50.2	6.3	6.1	100
D	63.7	27.5	3.4	5.5	100
E	48.3	41.8	1.4	8.5	100
F	18.3	67.5	8.5	5.7	100
G	17.4	70.0	4.9	7.7	100
H	33.4	35.8	1.5	29.2	100
I	53.8	37.4	4.8	4.0	100
J	52.2	44.7	1.0	2.1	100
K	41.1	48.1	2.9	7.9	100

Notes

1. The above table was based on Schedule 3, Part II, of the DOT Annual Returns for 1976 and 1977.

TABLE 16

Margin in weighted overall loss ratios for the 1976 cohort  
Based on weighted 1972 to 1975 incurred loss ratios

Company	Weighted Mean 1972-1975	Weighted SD 1972-1975	Weighted Mean 1976	Margin (no. of SD's)
A	.577	.063	.622	.7
B	.704	.107	.678	- .2
C	.549	.039	.641	2.4
D	.635	.033	.720	2.6
E	.588	.032	.706	3.7
F	.480	.057	.739	4.5
G	.542	.056	.696	2.8
H	.655	.031	.760	3.4
I	.535	.047	.611	1.6
J	.500	.031	.630	4.2
K	.562	.044	.580	.4
Mean of x	.575	.049	.671	2.4
SD of x				1.6
Mean of  x				2.4
SD of  x				1.5

Notes

1. The above table is similar to Table 13 but also allows for the 1976 earned premiums from Table 15.
2. The "weighted mean 1972-1975" was based on the weighted adjusted cohorts 1972 to 1975, the weights being the 1976 earned premiums. The "weighted SD 1972-1975" was based on the weighted formula

$$\left( \frac{\sum (wx)^2}{\sum w} \right)^{\frac{1}{2}},$$

the weights being the 1976 earned premiums. The "weighted mean 1976" refers to the unadjusted 1976 incurred mean, the weights being the 1976 earned premiums.



TABLE 17

Margin in weighted overall loss ratios for the 1977 cohort  
Based on weighted 1972 to 1976 incurred loss ratios

Company	Weighted Mean 1972-1976	Weighted SD 1972-1976	Weighted Mean 1977	Margin (no. of SD's)
A	.574	.049	.627	1.1
B	.698	.126	.735	.3
C	.560	.034	.655	2.8
D	.644	.028	.762	4.2
E	.611	.039	.732	3.1
F	.531	.110	.558	.2
G	.562	.073	.637	1.0
H	.668	.041	.738	1.7
I	.534	.040	.592	1.5
J	.513	.049	.591	1.6
K	.577	.039	.578	.03
Mean of x	.588	.057	.655	1.6
SD of x				1.3
Mean of  x				1.6
SD of  x				1.3

#### Notes

1. The above table is similar to Table 14 but also allows for the 1977 earned premiums from Table 15.
2. The "weighted mean 1972-1976" was based on the weighted adjusted cohorts 1972 to 1976, the weights being the 1977 earned premiums. The "weighted SD 1972-1976" was based on the weighted formula

$$\left( \frac{\sum (wx)^2}{\sum w} \right)^{\frac{1}{2}},$$

the weights being the 1977 earned premiums. The "weighted mean 1977" refers to the unadjusted 1977 incurred mean, the weights being the 1977 earned premiums.

## Summary of loss ratios for Company A

Adjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.		Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.72	.67	.65	.64	.61		.658	.039	.060	- .155
Fire	.34	.53	.63	.42	.50		.483	.097	.201	.919
Personal accident	.56	.57	.60	.59	.77		.616	.076	.123	- .122
Employers liability	.77	.74	.75	.75	.55		.711	.080	.113	.172
Mean	.598	.628	.658	.600	.608		.617	.025	.041	1.000
Standard deviation	.194	.095	.065	.137	.117		.097			
Coefficient of variation	.324	.152	.099	.229	.193		.158			
Coefficient of correlation	.986	.913	.639	.993	.261		1.000			
Unadjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.	1977 inc.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.68	.67	.71	.70	.64	.64	.675	.027	.041	.138
Fire	.49	.63	.69	.48	.59	.59	.580	.075	.130	.656
Personal accident	.56	.54	.58	.55	.76	.69	.611	.081	.133	.263
Employers liability	.63	.68	.77	.86	.59	.74	.711	.091	.128	.518
Mean	.590	.630	.688	.648	.645	.665	.644	.033	.052	1.000
Standard deviation	.083	.064	.079	.169	.080	.065	.060			
Coefficient of variation	.140	.101	.115	.260	.124	.097	.092			
Coefficient of correlation	.869	.664	.678	.988	-.287	.713	1.000			
Revenue Account loss ratios	1971 a/c.	1972 a/c.	1973 a/c.	1974 a/c.	1975 a/c.	1976 a/c.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Motor	.76	.76	.75	.85	.77	.67	.760	.057	.075	.922
Property	.48	.51	.53	.56	.50	.53	.518	.028	.054	.561
Liability	.66	.74	.79	.86	.75	.58	.730	.098	.135	.982
Mean	.633	.670	.690	.757	.673	.593	.669	.055	.083	1.000
Standard deviation	.142	.139	.140	.170	.150	.071	.132			
Coefficient of variation	.224	.207	.203	.225	.224	.120	.197			
Coefficient of correlation	.970	.999	.967	.990	.999	.840	1.000			

## Notes

1. The "adjusted incurred loss ratios" were based on Schedule 3, Parts II and III, of the DOT Annual Returns and allow for claim payments up to the 1977 Year of Account and for outstanding claims estimates at that date. The "unadjusted incurred loss ratios" are based on the original estimates. The Revenue Account loss ratios were based on Schedule 2, Part III, of the DOT Annual Returns.
2. The above table assumes that the company is writing an equal volume of premium income (i.e. earned premiums) for each risk group for each cohort.

TABLE 19

Data Appendix

## Summary of loss ratios for Company B

Adjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.		Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.67	.61	.64	.70	.76		.676	.052	.077	- .692
Fire	.31	.46	.53	.45	.92		.534	.206	.386	- .140
Personal accident	.48	.41	.46	.43	.49		.452	.030	.066	- .035
Employers liability	1.99	2.40	2.61	.89	.93		1.764	.726	.412	.938
Mean	.863	.970	1.060	.618	.775		.857	.172	.200	1.000
Standard deviation	.766	.957	1.036	.219	.205		.612			
Coefficient of variation	.888	.987	.977	.355	.265		.714			
Coefficient of correlation	.989	.998	.997	.900	.562		1.000			
Unadjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.	1977 inc.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.74	.74	.72	.71	.78	.84	.755	.045	.059	- .345
Fire	.38	.58	.64	.51	.54	.63	.548	.087	.160	.087
Personal accident	.54	.47	.53	.45	.49	.46	.491	.033	.067	.551
Employers liability	2.43	3.02	2.66	.83	1.02	1.05	1.835	.888	.484	.994
Mean	1.023	1.203	1.138	.625	.708	.745	.907	.245	.270	1.000
Standard deviation	.950	1.217	1.018	.176	.244	.256	.629			
Coefficient of variation	.928	1.011	.895	.282	.344	.344	.693			
Coefficient of correlation	.994	.996	.993	.877	.934	.887	1.000			
Revenue Account loss ratios	1971 a/c.	1972 a/c.	1973 a/c.	1974 a/c.	1975 a/c.	1976 a/c.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Motor	.74	.77	.78	.77	.41	.83	.717	.153	.213	.963
Property	.54	.54	.52	.59	.52	.61	.553	.038	.068	.487
Liability	.72	.88	.97	.78	.67	.86	.813	.111	.136	.845
Mean	.667	.730	.757	.713	.533	.767	.694	.087	.125	1.000
Standard deviation	.110	.173	.226	.107	.131	.137	.131			
Coefficient of variation	.165	.238	.298	.150	.245	.178	.189			
Coefficient of correlation	.894	.999	.998	.947	.446	.965	1.000			

## Notes

- The "adjusted incurred loss ratios" were based on Schedule 3, Parts II and III, of the DOT Annual Returns and allow for claim payments up to the 1977 Year of Account and for outstanding claims estimates at that date. The "unadjusted incurred loss ratios" are based on the original estimates. The Revenue Account loss ratios were based on Schedule 2, Part III, of the DOT Annual Returns.
- The above table assumes that the company is writing an equal volume of premium income (i.e. earned premiums) for each risk group for each cohort.

TABLE 20

Data Appendix

## Summary of loss ratios for Company C

Adjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.		Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.59	.57	.55	.58	.66		.590	.039	.065	.091
Fire	.41	.56	.57	.50	.54		.516	.060	.117	.945
Personal accident	.44	.48	.41	.41	.44		.437	.027	.061	.013
Employers liability	.71	.87	.94	.94	.86		.864	.083	.096	.848
Mean	.538	.620	.618	.608	.625		.602	.036	.060	1.000
Standard deviation	.139	.171	.226	.232	.181		.186			
Coefficient of variation	.259	.277	.366	.382	.289		.308			
Coefficient of correlation	.923	.988	.980	.999	.984		1.000			
Unadjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.	1977 inc.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.70	.67	.63	.64	.68	.72	.674	.032	.047	.368
Fire	.49	.65	.65	.61	.59	.60	.597	.052	.087	.584
Personal accident	.46	.49	.40	.41	.43	.46	.440	.030	.069	.346
Employers liability	1.02	1.26	1.06	1.22	1.09	.91	1.092	.119	.109	.895
Mean	.668	.768	.685	.720	.698	.673	.701	.037	.053	1.000
Standard deviation	.258	.338	.275	.349	.281	.191	.278			
Coefficient of variation	.386	.440	.401	.484	.403	.283	.397			
Coefficient of correlation	.972	.991	.986	.996	1.000	.971	1.000			
Revenue Account loss ratios	1971 a/c.	1972 a/c.	1973 a/c.	1974 a/c.	1975 a/c.	1976 a/c.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Motor	.73	.73	.76	.77	.82	.29	.683	.196	.286	.992
Property	.53	.52	.52	.62	.60	.37	.527	.088	.167	.943
Liability	.84	.82	.91	.93	.85	.39	.790	.200	.254	.988
Mean	.700	.690	.730	.773	.757	.350	.667	.158	.237	1.000
Standard deviation	.157	.154	.197	.155	.137	.053	.132			
Coefficient of variation	.225	.223	.269	.201	.180	.151	.198			
Coefficient of correlation	.998	.993	1.000	.992	.953	.083	1.000			

## Notes

- The "adjusted incurred loss ratios" were based on Schedule 3, Parts II and III, of the DOT Annual Returns and allow for claim payments up to the 1977 Year of Account and for outstanding claims estimates at that date. The "unadjusted incurred loss ratios" are based on the original estimates. The Revenue Account loss ratios were based on Schedule 2, Part III, of the DOT Annual Returns.
- The above table assumes that the company is writing an equal volume of premium income (i.e. earned premiums) for each risk group for each cohort.

TABLE 21

Data Appendix

## Summary of loss ratios for Company D

Adjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.		Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.69	.67	.66	.67	.67		.673	.007	.011	-.526
Fire	.43	.45	.67	.55	.61		.543	.094	.173	.763
Personal accident	.41	.44	.58	.60	.58		.524	.081	.155	.964
Employers liability	.78	.68	.83	1.14	.91		.868	.156	.180	.889
Mean	.578	.560	.685	.740	.693		.652	.078	.120	1.000
Standard deviation	.186	.133	.105	.271	.150		.158			
Coefficient of variation	.321	.237	.153	.366	.216		.243			
Coefficient of correlation	.947	.879	.921	.958	.982		1.000			
Unadjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.	1977 inc.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.70	.69	.69	.74	.72	.81	.724	.040	.055	.434
Fire	.53	.56	.79	.65	.70	.65	.645	.087	.135	.773
Personal accident	.50	.46	.63	.62	.57	.53	.550	.063	.114	.877
Employers liability	.76	.78	.81	1.04	.95	.89	.871	.097	.112	.833
Mean	.623	.623	.730	.763	.735	.720	.698	.061	.087	1.000
Standard deviation	.127	.141	.085	.192	.158	.161	.136			
Coefficient of variation	.204	.226	.116	.252	.215	.224	.195			
Coefficient of correlation	.943	.981	.706	.953	.980	.968	1.000			
Revenue Account loss ratios	1971 a/c.	1972 a/c.	1973 a/c.	1974 a/c.	1975 a/c.	1976 a/c.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Motor	.69	.67	.69	.72	.80	.68	.708	.049	.068	.947
Property	.56	.54	.54	.69	.66	.61	.600	.064	.107	.851
Liability	.69	.70	.75	.83	.94	.68	.765	.102	.133	.971
Mean	.647	.637	.660	.747	.800	.657	.691	.066	.096	1.000
Standard deviation	.075	.085	.108	.074	.140	.040	.084			
Coefficient of variation	.116	.134	.164	.099	.175	.062	.121			
Coefficient of correlation	.940	.986	.998	.880	.984	.940	1.000			

## Notes

1. The "adjusted incurred loss ratios" were based on Schedule 3, Parts II and III, of the DOT Annual Returns and allow for claim payments up to the 1977 Year of Account and for outstanding claims estimates at that date. The "unadjusted incurred loss ratios" are based on the original estimates. The Revenue Account loss ratios were based on Schedule 2, Part III, of the DOT Annual Returns.
2. The above table assumes that the company is writing an equal volume of premium income (i.e. earned premiums) for each risk group for each cohort.

TABLE 22

Data Appendix

## Summary of loss ratios for Company E

Adjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.		Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.71	.62	.63	.64	.67		.653	.032	.049	.051
Fire	.40	.49	.54	.47	.66		.511	.086	.169	.932
Personal accident	.46	.51	.47	.50	.52		.493	.024	.049	.653
Employers liability	.86	.90	.87	.83	.97		.885	.047	.053	.949
Mean	.608	.630	.628	.610	.705		.636	.040	.063	1.000
Standard deviation	.215	.189	.174	.164	.189		.181			
Coefficient of variation	.354	.300	.278	.269	.269		.285			
Coefficient of correlation	.955	.992	.991	.992	.947		1.000			
Unadjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.	1977 inc.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.69	.65	.64	.66	.65	.70	.665	.020	.030	.126
Fire	.54	.63	.66	.56	.73	.72	.640	.073	.113	.936
Personal accident	.43	.48	.49	.44	.48	.47	.464	.021	.046	.643
Employers liability	.92	.85	.96	.79	1.03	1.02	.930	.088	.095	.951
Mean	.645	.653	.688	.613	.723	.728	.675	.046	.068	1.000
Standard deviation	.212	.152	.197	.149	.230	.226	.192			
Coefficient of variation	.329	.233	.286	.242	.318	.310	.285			
Coefficient of correlation	.971	.999	.992	.969	.980	.995	1.000			
Revenue Account loss ratios	1971 a/c.	1972 a/c.	1973 a/c.	1974 a/c.	1975 a/c.	1976 a/c.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Motor	.77	.88	.75	.73	.73	.73	.765	.059	.077	.850
Property	.54	.60	.52	.56	.52	.60	.557	.037	.066	.605
Liability	.67	1.11	.96	.75	.62	.80	.818	.185	.226	.976
Mean	.660	.863	.743	.680	.623	.710	.713	.084	.118	1.000
Standard deviation	.115	.255	.220	.104	.105	.101	.138			
Coefficient of variation	.175	.296	.296	.154	.169	.143	.193			
Coefficient of correlation	.801	.963	.954	.995	.736	.987	1.000			

## Notes

1. The "adjusted incurred loss ratios" were based on Schedule 3, Parts II and III, of the DOT Annual Returns and allow for claim payments up to the 1977 Year of Account and for outstanding claims estimates at that date. The "unadjusted incurred loss ratios" are based on the original estimates. The Revenue Account loss ratios were based on Schedule 2, Part III, of the DOT Annual Returns.
2. The above table assumes that the company is writing an equal volume of premium income (i.e. earned premiums) for each risk group for each cohort.

## Summary of loss ratios for Company F

Adjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.		Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.67	.56	.64	.59	.61		.615	.037	.061	.248
Fire	.33	.41	.53	.43	.80		.502	.163	.324	.674
Personal accident	.44	.39	.54	.41	.38		.433	.057	.131	.446
Employers liability	.77	.89	.77	.66	.64		.743	.089	.120	-.013
Mean	.553	.563	.620	.523	.608		.573	.040	.070	1.000
Standard deviation	.203	.231	.112	.122	.173		.136			
Coefficient of variation	.367	.411	.180	.233	.285		.237			
Coefficient of correlation	.890	.962	.966	.976	.338		1.000			
Unadjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.	1977 inc.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.62	.56	.61	.65	.61	.68	.623	.037	.060	.332
Fire	.39	.48	.58	.47	.83	.53	.546	.140	.256	.817
Personal accident	.42	.41	.53	.42	.38	.45	.434	.046	.105	.291
Employers liability	.56	.58	.64	.61	.59	.66	.608	.035	.057	.662
Mean	.498	.508	.590	.538	.603	.580	.553	.044	.080	1.000
Standard deviation	.110	.078	.047	.110	.134	.109	.086			
Coefficient of variation	.221	.154	.079	.204	.305	.186	.155			
Coefficient of correlation	.774	.967	.940	.929	.522	.967	1.000			
Revenue Account loss ratios	1971 a/c.	1972 a/c.	1973 a/c.	1974 a/c.	1975 a/c.	1976 a/c.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Motor	.73	.71	.75	.78	.75	.66	.730	.041	.057	.103
Property	.50	.49	.48	.54	.49	.65	.525	.065	.123	.262
Liability	.77	.72	.93	.75	.69	.76	.770	.084	.109	.854
Mean	.667	.640	.720	.690	.643	.690	.675	.031	.046	1.000
Standard deviation	.146	.130	.226	.131	.136	.061	.131			
Coefficient of variation	.218	.203	.315	.190	.212	.088	.195			
Coefficient of correlation	1.000	.993	.967	.964	.931	.688	1.000			

## Notes

1. The "adjusted incurred loss ratios" were based on Schedule 3, Parts II and III, of the DOT Annual Returns and allow for claim payments up to the 1977 Year of Account and for outstanding claims estimates at that date. The "unadjusted incurred loss ratios" are based on the original estimates. The Revenue Account loss ratios were based on Schedule 2, Part III, of the DOT Annual Returns.
2. The above table assumes that the company is writing an equal volume of premium income (i.e. earned premiums) for each risk group for each cohort.

TABLE 24

Data Appendix

## Summary of loss ratios for Company G

Adjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.		Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.72	.62	.68	.71	.69		.684	.038	.055	- .211
Fire	.42	.47	.56	.38	.66		.499	.102	.204	.467
Personal accident	.64	.51	.68	.69	.60		.624	.064	.103	- .093
Employers liability	.91	1.03	.91	.59	.66		.820	.165	.201	.694
Mean	.673	.658	.708	.593	.653		.657	.042	.064	1.000
Standard deviation	.203	.256	.146	.151	.038		.133			
Coefficient of variation	.301	.390	.207	.255	.058		.203			
Coefficient of correlation	.998	.919	.964	.548	.184		1.000			
Unadjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.	1977 inc.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.66	.62	.59	.72	.76	.63	.663	.057	.085	.170
Fire	.49	.51	.57	.39	.69	.61	.543	.095	.175	.747
Personal accident	.62	.47	.60	.51	.64	.72	.592	.083	.139	.744
Employers liability	.44	.67	.71	.74	.60	.85	.669	.128	.192	.590
Mean	.553	.568	.618	.590	.673	.703	.617	.060	.097	1.000
Standard deviation	.104	.093	.063	.169	.069	.109	.060			
Coefficient of variation	.189	.164	.102	.287	.102	.156	.098			
Coefficient of correlation	.108	.856	.658	.999	-.018	.543	1.000			
Revenue Account loss ratios	1971 a/c.	1972 a/c.	1973 a/c.	1974 a/c.	1975 a/c.	1976 a/c.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Motor	.73	.81	.77	.84	.94	.59	.780	.117	.150	.877
Property	.48	.52	.53	.56	.50	.41	.500	.052	.104	.954
Liability	.67	.74	.89	1.02	.80	.11	.705	.316	.448	.990
Mean	.627	.690	.730	.807	.747	.370	.662	.155	.234	1.000
Standard deviation	.131	.151	.183	.232	.225	.242	.145			
Coefficient of variation	.208	.219	.251	.287	.301	.655	.219			
Coefficient of correlation	1.000	1.000	.828	.790	.998	.118	1.000			

## Notes

1. The "adjusted incurred loss ratios" were based on Schedule 3, Parts II and III, of the DOT Annual Returns and allow for claim payments up to the 1977 Year of Account and for outstanding claims estimates at that date. The "unadjusted incurred loss ratios" are based on the original estimates. The Revenue Account loss ratios were based on Schedule 2, Part III, of the DOT Annual Returns.
2. The above table assumes that the company is writing an equal volume of premium income (i.e. earned premiums) for each risk group for each cohort.



TABLE 25

Data Appendix

## Summary of loss ratios for Company H

Adjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.		Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.61	.64	.60	.63	.60		.613	.015	.025	- .224
Fire	.56	.50	.55	.51	.76		.576	.097	.169	.266
Personal accident	.81	.74	.65	.69	.58		.693	.079	.114	.500
Employers liability	.96	.87	.84	.73	.83		.846	.073	.086	.923
Mean	.735	.688	.660	.640	.693		.682	.036	.053	1.000
Standard deviation	.185	.156	.127	.096	.122		.120			
Coefficient of variation	.251	.227	.192	.150	.176		.176			
Coefficient of correlation	.977	.955	.993	.864	.469		1.000			
Unadjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.	1977 inc.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.64	.63	.64	.65	.63	.71	.650	.026	.040	.208
Fire	.68	.56	.59	.55	.82	.67	.646	.091	.140	.923
Personal accident	.68	.69	.57	.74	.71	.63	.669	.056	.084	.280
Employers liability	.87	.78	.81	.74	.82	.86	.813	.044	.054	.629
Mean	.718	.665	.653	.670	.745	.718	.695	.037	.053	1.000
Standard deviation	.103	.093	.109	.091	.093	.100	.080			
Coefficient of variation	.144	.140	.167	.135	.124	.140	.115			
Coefficient of correlation	.983	.881	.935	.611	.509	.906	1.000			
Revenue Account loss ratios	1971 a/c.	1972 a/c.	1973 a/c.	1974 a/c.	1975 a/c.	1976 a/c.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Motor	.80	.69	.67	.68	.67	.69	.700	.050	.071	.014
Property	.52	.47	.44	.54	.55	.69	.535	.087	.162	.320
Liability	1.24	.37	1.40	1.46	1.62	1.10	1.198	.444	.370	.976
Mean	.853	.510	.837	.893	.947	.827	.811	.154	.190	1.000
Standard deviation	.363	.164	.501	.496	.586	.237	.345			
Coefficient of variation	.425	.321	.599	.555	.619	.286	.426			
Coefficient of correlation	.988	-.559	1.000	.995	.990	.971	1.000			

## Notes

- The "adjusted incurred loss ratios" were based on Schedule 3, Parts II and III, of the DOT Annual Returns and allow for claim payments up to the 1977 Year of Account and for outstanding claims estimates at that date. The "unadjusted incurred loss ratios" are based on the original estimates. The Revenue Account loss ratios were based on Schedule 2, Part III, of the DOT Annual Returns.
- The above table assumes that the company is writing an equal volume of premium income (i.e. earned premiums) for each risk group for each cohort.

TABLE 26

Data Appendix

Summary of loss ratios for Company I

Adjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.		Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.58	.57	.56	.56	.53		.563	.017	.029	- .444
Fire	.34	.41	.65	.50	.52		.484	.104	.215	.980
Personal accident	.51	.53	.55	.60	.57		.550	.033	.061	.360
Employers liability	.58	.57	.73	.51	.62		.602	.072	.120	.804
Mean	.503	.520	.623	.543	.560		.550	.046	.084	1.000
Standard deviation	.113	.076	.085	.046	.045		.049			
Coefficient of variation	.225	.146	.136	.086	.081		.089			
Coefficient of correlation	.945	.943	.238	.196	.802		1.000			
Unadjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.	1977 inc.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.61	.58	.60	.56	.56	.63	.592	.025	.042	- .660
Fire	.45	.49	.70	.58	.70	.56	.581	.094	.162	.887
Personal accident	.53	.54	.55	.60	.58	.51	.550	.032	.059	.685
Employers liability	.58	.65	.55	.57	.58	.48	.571	.051	.088	.186
Mean	.543	.565	.600	.578	.605	.545	.574	.027	.046	1.000
Standard deviation	.070	.068	.071	.017	.064	.066	.018			
Coefficient of variation	.129	.120	.118	.030	.106	.120	.031			
Coefficient of correlation	.201	.025	.541	-.891	.154	.760	1.000			
Revenue Account loss ratios	1971 a/c.	1972 a/c.	1973 a/c.	1974 a/c.	1975 a/c.	1976 a/c.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Motor	.70	.65	.67	.71	.71	.68	.687	.024	.035	.288
Property	.43	.48	.47	.57	.59	.63	.528	.079	.150	.897
Liability	.62	.60	.66	.54	.60	.68	.617	.050	.080	.401
Mean	.583	.577	.600	.607	.633	.663	.611	.032	.053	1.000
Standard deviation	.139	.087	.113	.091	.067	.029	.080			
Coefficient of variation	.238	.151	.188	.149	.105	.044	.130			
Coefficient of correlation	.987	.986	.917	.726	.869	.898	1.000			

Notes

1. The "adjusted incurred loss ratios" were based on Schedule 3, Parts II and III, of the DOT Annual Returns and allow for claim payments up to the 1977 Year of Account and for outstanding claims estimates at that date. The "unadjusted incurred loss ratios" are based on the original estimates. The Revenue Account loss ratios were based on Schedule 2, Part III, of the DOT Annual Returns.
2. The above table assumes that the company is writing an equal volume of premium income (i.e. earned premiums) for each risk group for each cohort.

TABLE 27

Data Appendix

## Summary of loss ratios for Company J

Adjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.		Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.59	.56	.55	.51	.51		.544	.030	.055	- .472
Fire	.41	.35	.45	.49	.66		.474	.105	.221	.883
Personal accident	.41	.40	.48	.49	.50		.456	.041	.090	.783
Employers liability	.68	.53	.66	.60	.62		.618	.054	.088	.646
Mean	.523	.460	.535	.523	.573		.523	.041	.078	1.000
Standard deviation	.135	.101	.093	.053	.080		.074			
Coefficient of variation	.258	.220	.174	.100	.139		.141			
Coefficient of correlation	.984	.812	.970	.934	.213		1.000			
Unadjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.	1977 inc.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.54	.54	.64	.60	.58	.60	.583	.035	.060	.566
Fire	.41	.36	.49	.53	.70	.58	.512	.108	.211	.969
Personal accident	.42	.42	.46	.50	.53	.49	.469	.039	.084	.944
Employers liability	.65	.50	.58	.63	.64	.64	.607	.050	.082	.723
Mean	.505	.455	.543	.565	.613	.578	.543	.056	.104	1.000
Standard deviation	.113	.081	.083	.060	.074	.063	.064			
Coefficient of variation	.224	.177	.152	.107	.120	.110	.117			
Coefficient of correlation	.921	.768	.890	.996	.274	.933	1.000			
Revenue Account loss ratios	1971 a/c.	1972 a/c.	1973 a/c.	1974 a/c.	1975 a/c.	1976 a/c.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Motor	.66	.57	.57	.68	.62	.54	.607	.056	.092	.838
Property	.42	.45	.39	.55	.50	.63	.490	.089	.182	- .055
Liability	.93	.71	.76	.68	.66	.59	.722	.117	.161	.638
Mean	.670	.577	.573	.637	.593	.587	.606	.039	.064	1.000
Standard deviation	.255	.130	.185	.075	.083	.045	.116			
Coefficient of variation	.381	.226	.323	.118	.140	.077	.191			
Coefficient of correlation	.999	.999	1.000	.869	.962	-.448	1.000			

## Notes

- The "adjusted incurred loss ratios" were based on Schedule 3, Parts II and III, of the DOT Annual Returns and allow for claim payments up to the 1977 Year of Account and for outstanding claims estimates at that date. The "unadjusted incurred loss ratios" are based on the original estimates. The Revenue Account loss ratios were based on Schedule 2, Part III, of the DOT Annual Returns.
- The above table assumes that the company is writing an equal volume of premium income (i.e. earned premiums) for each risk group for each cohort.

TABLE 28

Data Appendix

## Summary of loss ratios for Company K

Adjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.		Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.67	.64	.67	.68	.75		.682	.039	.057	.816
Fire	.32	.43	.49	.35	.39		.397	.060	.151	.396
Personal accident	.48	.44	.76	.95	1.57		.839	.412	.491	.823
Employers liability	1.22	1.13	1.27	.76	.75		1.025	.226	.221	-.296
Mean	.673	.660	.798	.685	.865		.736	.091	.123	1.000
Standard deviation	.392	.328	.334	.250	.500		.266			
Coefficient of variation	.583	.497	.419	.366	.578		.361			
Coefficient of correlation	.825	.735	.914	.815	.519		1.000			
Unadjusted incurred loss ratios	1972 inc.	1973 inc.	1974 inc.	1975 inc.	1976 inc.	1977 inc.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Private cars	.61	.57	.67	.67	.66	.71	.648	.043	.066	.730
Fire	.45	.53	.57	.41	.47	.38	.467	.066	.141	.091
Personal accident	.48	.39	.71	.54	.90	1.51	.753	.375	.498	.766
Employers liability	.59	.87	1.40	.74	.81	.76	.860	.255	.297	.628
Mean	.533	.590	.838	.590	.710	.840	.682	.134	.196	1.000
Standard deviation	.079	.202	.380	.146	.188	.477	.167			
Coefficient of variation	.149	.342	.453	.247	.265	.568	.246			
Coefficient of correlation	.542	.485	.809	.807	.895	.570	1.000			
Revenue Account loss ratios	1971 a/c.	1972 a/c.	1973 a/c.	1974 a/c.	1975 a/c.	1976 a/c.	Mean	Standard deviation	Coefficient of variation	Coefficient of correlation
Motor	.79	.69	.70	.88	.85	.77	.780	.077	.099	.946
Property	.41	.39	.42	.54	.57	.67	.500	.111	.223	.601
Liability	.71	.69	.74	.95	.82	.57	.747	.128	.172	.724
Mean	.637	.590	.620	.790	.747	.670	.676	.078	.115	1.000
Standard deviation	.200	.173	.174	.219	.154	.100	.153			
Coefficient of variation	.314	.294	.281	.278	.206	.149	.226			
Coefficient of correlation	.996	.994	.975	.964	1.000	.108	1.000			

## Notes

- The "adjusted incurred loss ratios" were based on Schedule 3, Parts II and III, of the DOT Annual Returns and allow for claim payments up to the 1977 Year of Account and for outstanding claims estimates at that date. The "unadjusted incurred loss ratios" are based on the original estimates. The Revenue Account loss ratios were based on Schedule 2, Part III, of the DOT Annual Returns.
- The above table assumes that the company is writing an equal volume of premium income (i.e. earned premiums) for each risk group for each cohort.

Chain-Ladder Method

W.W.Truckle

1. Introduction

This investigation is not concerned with theoretical considerations of the chain-ladder method as a means of testing claims reserves.

Its aim is the intellectually modest one of examining empirically the results of applying the method to a broad selection of claims data published in schedule 3 part III of the statutory DoT returns; with a view to obtaining a general 'feel' for the way in which the method works in practice.

2. Sources of data

The data are taken from -

- (a) The NU database which holds details of the returns of 11 major companies.
- (b) The GAD database which holds details of 34 companies of various sizes, including the above 11.

3. Scope of inquiry

- 3.1 In order to contain the work within reasonable bounds the investigation is limited to the following risk groups which may be regarded as being fairly uniformly defined as between companies; and which are representative of the range of class-of-business characteristics -

Private Car  
Employers Liability  
Personal Accident  
Fire

- 3.2 Two variants of the chain-ladder method have been tested -

- (a) The 'basic' version which uses the accumulated claims payments without adjustment.
- (b) The 'inflation-adjusted' version which adjusts the claims payments to allow for past and future inflation.

- 3.3 As between the NU and GAD databases there is a difference with regard to the base year which forms the starting-point of the derivation of the chain-ladder multipliers -

NU database starts with year 1970  
GAD database starts with year 1971.

4. Output

The computer programs are designed to produce the results of the chain-ladder calculations in considerable detail including the underlying derived run-off factors. The output is far too voluminous to be included in this report; and the results relevant to the present investigation are therefore summarised in the attached appendices A to F. The figures in these appendices are the material for the following discussion.

5. Appendix A

- 5.1 Under the main heading 'Provision at end-1975' the various columns are defined as follows:-

Original assessment : The total provision for claims outstanding at end-1975 resulting from the application of the chain-ladder method at that date.

Re-assessment at end-1976 : In respect of claims outstanding at end-1975 the sum of the corresponding claims payments during 1976 plus the provision for the residue of claims outstanding at end-1976 as then assessed by the chain-ladder method.

Re-assessment at end-1977 : In respect of claims outstanding at end-1975 the sum of the corresponding claims payments during 1976 and 1977 plus the provision for the residue of claims outstanding at end-1977 as then assessed by the chain-ladder method.

The columns under the main heading 'Provision at end-1976' are defined correspondingly.

- 5.2 The successive re-assessments provide progressively more accurate estimates of the true provision originally required.

- 5.3 Let us assume that the end-1977 re-assessment is an accurate indication of the provision actually required at end-1975. Then we can make the following broad observations regarding the accuracy of the basic chain ladder method as applied to 11 of the largest companies.

- (i) The range of percentage error is -

Private Car : - 21% to + 24%.

Employers Liability : - 46% to + 24%

Personal Accident : - 74% to + 15% (ignoring LG result)

Fire : - 15% to + 34%

Combined : - 8% to + 24%

- (ii) The development of the end-1976 position after one year is quite different from the corresponding stage of development of the end-1975 position. The implication being that there is no consistency in the method's performance in successive years.

- (iii) There are notable differences in the results for different risk groups, these being particularly marked in the case of individual companies.

6. Appendix B

6.1 This provides a set of results of the inflation-adjusted chain-ladder method comparable to those of Appendix A.

6.2 The range of percentage error is -

Private Car : - 22% to + 22%

Employers Liability : - 47% to + 16%

Personal Accident : - 80% to + 14% (ignoring LG result)

Fire : - 13% to + 27%

Combined : - 8% to + 21%

6.3 Overall there is a small improvement in the accuracy of the inflation-adjusted method as compared with the basic method; but this is barely noticeable against the total range of errors.

7. Appendices C and D

7.1 These present a summary of results taken from the GAD database which are comparable with Appendices A and B.

7.2 The results include the 11 companies which were the subject of Appendices A and B. The differences in the results are caused by the choice of base year (NU database = 1970, GAD database = 1971).

These differences for the 11 companies combined may be summarised as follows:-

	Percentage difference between using base-year (i) 1970 and (ii) 1971. Values of (ii) + (i) per cent.			
	Position at end-1975			
	BASIC		INFLATION-ADJUSTED	
	Original assessment	Re-assessment at end-1977	Original assessment	Re-assessment at end-1977
Private Car	104	104	95	100
Employers Liability	105	100	96	96
Personal Accident	105	102	101	100
Fire	101	102	100	102
Total	104	102	97	99

	Percentage difference between using base-year (i) 1970 and (ii) 1971. Values of (ii) + (i) per cent.			
	Position at end-1976			
	BASIC		INFLATION-ADJUSTED	
	Original assessment	Re-assessment at end-1977	Original assessment	Re-assessment at end-1977
Private Car	104	105	95	99
Employers Liability	108	102	98	95
Personal Accident	107	102	102	100
Fire	101	102	98	100
Total	105	103	97	100

These figures suggest that the choice of base-year affects the results produced by the chain-ladder method. Examination of individual company results shows some very marked differences.

- 7.3 The GAD database extends to companies other than the 11 major ones dealt with above.

Looking at the provision for the 'non-major' companies at end-1975 and comparing it with the re-assessment at end-1977 the range of percentage errors in the basic method (corresponding to those in 5.3(i) above) is -

Private Car : - 23% to + 32%

Employers Liability : - 34% to + 83%

Personal Accident : - 185% to + 31%

Fire : - 42% to + 70%.

For the inflation-adjusted version the range of errors (corresponding to those in 6.2 above) is -

Private Car : - 25% to + 28%

Employers Liability : - 44% to + 79%

Personal Accident : - 198% to + 31%

Fire : - 42% to + 73%

## 8. Appendices E and F

- 8.1 The essential rationale of the chain-ladder method is to develop a series of weighted mean run-off multipliers which are used to scale-up the accumulated payments to the projected ultimate liability for each year of origin.



- 8.2 In the left-hand portion of Appendices E and F the multipliers implicit in the NU database chain-ladder results at end-1977 have been extracted. The multipliers actually shown are those which produce the outstanding reserve (rather than the ultimate liability).
- 8.3 The idea behind the investigation is to examine the possibilities of being able to define a 'standard table' of run-off factors for each risk-group.
- 8.4 It is apparent that each of the four risk-groups considered exhibits a distinctive run-off pattern. But it is also clear that there are marked variations among companies within each risk-group.
- 8.5 Further detailed examination of each company's results reveals another marked source of variation.

The chain-ladder calculation uses weighted mean-value multipliers; but for individual years of origin that are wide deviations between the highest and lowest corresponding multipliers. The right-hand portion of the appendices shows for a few selected examples the effect on the projected reserve of using the lowest and highest set of multipliers respectively instead of the mean value.

- 8.6 The only prospect of developing the concept of a 'standard table' might be in specifying a 'worst-possible' sequence of multipliers based on the highest experienced values for each company for each risk-group.
9. The purpose of this investigation has not been to arrive at firm conclusions as to the efficacy of the chain-ladder method. Rather it has been to try to use a wide range of actual results to expose its strengths and weaknesses; and to provoke discussion and, possibly, further research.

## NU database (Base year 1970)

Risk Group	Company	BASIC Chain-ladder Results							
		Provision at end-1975					Provision at end-1976		
		Original assessment Amount £000	Re-assessment at end - 1976		Re-assessment at end - 1977		Original assessment Amount £000	Re-assessment at end - 1977	
			Amount £000	%	Amount £000	%		Amount £000	%
Private Car	NU	12,784	12,073	94	11,622	91	13,415	12,484	93
	CU	14,535	14,262	98	13,004	89	17,403	16,835	97
	ROY	8,060	7,885	98	7,993	99	10,437	11,236	108
	GA	41,813	35,721	85	34,164	82	43,114	41,488	96
	GRE	31,734	27,723	87	24,120	76	34,026	29,136	86
	SAL	8,347	9,094	109	8,614	103	10,509	9,644	92
	PHX	3,067	3,430	112	3,145	103	4,082	3,691	90
	ES	15,237	14,591	96	14,645	96	17,313	18,289	106
	PRU	10,572	10,216	97	10,545	100	11,675	12,365	106
	COOP	17,183	15,271	89	16,148	94	17,854	18,801	105
	LG	5,482	5,941	108	6,651	121	6,553	7,650	117
	Total	168,814	156,207	93	150,651	89	186,381	181,619	97
Empl. Liability	NU	4,041	4,223	105	4,409	109	4,669	4,326	93
	CU	19,171	17,779	93	18,457	96	19,905	20,032	101
	ROY	5,542	7,048	127	7,518	136	6,826	8,002	117
	GA	6,147	7,847	128	7,259	118	8,958	8,308	93
	GRE	10,509	8,884	85	7,973	76	10,532	9,767	93
	SAL	7,802	7,194	92	6,186	79	7,055	6,550	93
	PHX	4,744	5,310	112	5,024	106	5,708	5,363	94
	ES	40,227	38,896	97	41,124	102	46,049	49,246	107
	PRU	1,304	1,170	90	1,899	146	1,331	2,176	163
	COOP	1,601	1,309	82	1,447	90	1,335	1,831	137
	LG	2,095	2,547	122	2,419	115	3,366	2,577	77
	Total	103,183	102,207	99	103,715	101	115,734	118,178	102
Pers. Accident	NU	988	969	98	1,067	108	1,127	1,255	111
	CU	496	763	154	854	172	821	1,108	135
	ROY	728	851	117	879	121	916	1,097	120
	GA	673	734	109	724	108	862	815	95
	GRE	302	507	168	519	172	381	508	133
	SAL	1,199	1,330	111	1,403	117	1,084	1,664	154
	PHX	172	306	178	300	174	211	245	116
	ES	670	606	90	571	85	535	469	88
	PRU	348	360	103	373	107	378	402	106
	COOP	136	126	93	132	97	144	153	106
	LG	28	118	421	154	550	50	335	670
	Total	5,740	6,670	116	6,976	122	6,509	8,051	124
Fire	NU	6,390	6,246	98	5,533	87	7,748	5,962	77
	CU	11,994	10,907	91	10,816	90	16,310	13,430	82
	ROY	12,149	11,202	92	12,247	101	14,676	12,983	88
	GA	9,973	9,360	94	9,222	92	13,267	11,142	84
	GRE	9,888	7,320	74	7,337	74	12,890	10,108	78
	SAL	14,495	13,545	93	13,867	96	25,513	21,721	85
	PHX	5,896	5,239	89	4,890	83	7,864	6,542	83
	ES	11,827	9,093	77	9,525	81	14,726	16,564	112
	PRU	4,831	4,425	92	4,572	95	5,645	6,179	109
	COOP	3,222	3,672	114	3,715	115	5,036	5,805	115
	LG	4,289	3,469	81	2,839	66	4,647	3,029	65
	Total	94,955	84,478	89	84,563	89	128,322	113,465	88
Combined	NU	24,203	23,511	97	22,631	94	26,959	24,027	89
	CU	46,196	43,711	95	43,131	93	54,439	51,405	94
	ROY	26,479	26,986	102	28,637	108	32,855	33,318	101
	GA	58,606	53,662	92	51,366	88	66,201	61,753	93
	GRE	52,433	44,434	85	39,949	76	57,829	49,519	86
	SAL	31,844	31,163	98	30,070	94	44,161	39,579	90
	PHX	13,879	14,285	103	13,359	96	17,865	15,841	89
	ES	67,961	63,186	93	65,865	97	78,623	84,568	108
	PRU	17,055	16,171	95	17,389	102	19,029	21,122	111
	COOP	22,142	20,378	92	21,442	97	24,369	25,590	109
	LG	11,894	12,075	102	12,063	101	14,616	13,591	93
	Total	372,692	349,562	94	345,905	93	436,946	421,313	96

## NU database (Base year 1970)

Risk Group	Company	INFLATION-ADJUSTED Chain-ladder Results							
		Provision at end-1975					Provision at end-1976		
		Original assessment Amount £000	Re-assessment at end - 1976		Re-assessment at end - 1977		Original assessment Amount £000	Re-assessment at end - 1977	
			Amount £000	%	Amount £000	%		Amount £000	%
Private Car	NU	12,379	11,654	94	11,437	92	12,578	12,171	97
	CU	14,526	14,012	96	12,921	89	16,685	16,665	100
	ROY	8,046	7,759	96	7,905	98	10,008	11,064	111
	GA	41,282	35,262	85	33,948	82	41,362	41,099	99
	GRE	31,037	27,122	87	24,123	78	32,551	29,056	89
	SAL	8,268	8,873	107	8,472	102	9,972	9,413	94
	PHX	3,022	3,322	110	3,105	103	3,842	3,627	94
	ES	15,231	14,308	94	14,477	95	16,664	18,002	108
	PRU	10,566	10,031	95	10,421	99	11,192	12,137	108
	COOP	17,055	15,007	88	15,950	94	17,223	18,475	107
	LG	5,300	5,642	106	6,485	122	5,994	7,385	123
	Total	166,712	152,992	92	149,244	90	178,091	179,094	101
Empl. Liability	NU	3,754	3,941	105	4,291	114	4,206	4,180	99
	CU	18,533	16,922	91	18,039	97	18,730	19,471	104
	ROY	5,238	6,688	128	7,383	141	6,268	7,840	125
	GA	5,678	7,277	128	7,138	126	7,999	8,160	102
	GRE	9,058	8,448	93	7,882	87	9,421	9,757	104
	SAL	7,383	6,803	92	6,187	84	6,552	6,578	100
	PHX	4,311	4,877	113	4,912	114	5,088	5,252	103
	ES	38,310	36,871	96	40,192	105	42,902	48,316	113
	PRU	1,286	1,143	89	1,890	147	1,293	2,170	168
	COOP	1,507	1,257	83	1,396	93	1,264	1,751	139
	LG	1,916	2,378	124	2,326	121	3,008	2,480	82
	Total	96,974	96,605	100	101,636	105	106,731	115,955	109
Pers. Accident	NU	989	956	97	1,071	108	1,062	1,257	118
	CU	516	765	148	853	165	773	1,101	142
	ROY	724	850	117	880	122	859	1,094	127
	GA	646	727	113	723	112	784	810	103
	GRE	288	502	174	517	180	333	501	150
	SAL	1,183	1,317	111	1,401	118	1,012	1,647	163
	PHX	166	295	178	298	180	182	236	130
	ES	667	606	91	575	86	517	477	92
	PRU	344	361	105	374	109	355	401	113
	COOP	138	124	90	132	96	144	153	106
	LG	26	117	450	154	592	50	335	670
	Total	5,687	6,620	116	6,978	123	6,071	8,012	132
Fire	NU	6,370	6,256	98	5,595	88	7,513	5,952	79
	CU	12,222	10,932	89	10,844	89	16,285	13,293	82
	ROY	12,225	11,270	92	12,147	99	14,522	12,694	87
	GA	9,955	9,351	94	9,181	92	13,012	10,949	84
	GRE	10,188	7,407	73	7,404	73	13,228	10,132	77
	SAL	14,644	13,605	93	13,861	95	25,061	21,448	86
	PHX	5,908	5,271	89	4,933	84	7,762	6,531	84
	ES	12,665	9,250	73	9,579	76	15,348	16,467	107
	PRU	4,841	4,433	92	4,518	93	5,506	6,014	109
	COOP	3,277	3,674	112	3,688	113	4,956	5,755	116
	LG	4,445	3,553	80	2,893	65	4,621	3,098	67
	Total	96,740	85,002	88	84,643	88	127,814	112,333	88
Combined	NU	23,492	22,807	97	22,394	95	25,359	23,560	93
	CU	45,797	42,631	93	42,657	93	52,473	50,530	96
	ROY	26,233	26,567	101	28,315	108	31,657	32,692	103
	GA	57,561	52,617	91	50,990	89	63,177	61,018	97
	GRE	50,571	43,479	86	39,926	79	55,533	49,446	89
	SAL	31,478	30,598	97	29,921	95	42,597	39,086	92
	PHX	13,407	13,765	103	13,248	99	16,874	15,646	93
	ES	66,873	61,035	91	64,823	97	75,431	83,262	110
	PRU	17,037	15,968	94	17,203	101	18,346	20,722	113
	COOP	21,977	20,062	91	21,166	96	23,587	26,134	111
	LG	11,687	11,690	100	11,858	101	13,673	13,298	97
	Total	366,113	341,219	93	342,501	94	418,707	415,394	99

## GAD database (Base year 1971)

Risk Group	Company	BASIC Chain-ladder Results							
		Provision at end-1975					Provision at end-1976		
		Original assessment Amount £000	Re-assessment at end - 1976		Re-assessment at end - 1977		Original assessment Amount £000	Re-assessment at end - 1977	
			Amount £000	%	Amount £000	%		Amount £000	%
Private Car	NU	14,873	13,946	94	13,492	91	15,908	14,932	94
	CU	13,648	13,207	97	12,204	89	16,009	15,831	99
	ROY	9,121	8,344	91	8,436	92	11,146	11,949	107
	GA	39,369	35,904	91	34,968	89	44,080	42,888	97
	GRE	31,595	25,982	82	23,072	73	32,164	28,043	87
	SAL	10,274	9,794	95	9,368	91	11,532	10,710	93
	PHX	2,898	2,802	97	2,347	81	2,949	2,367	80
	ES	15,362	15,286	100	14,628	95	18,324	18,520	101
	PRU	11,169	10,535	94	10,753	96	12,206	12,767	105
	COOP	17,825	16,124	90	16,374	92	18,616	18,973	102
	LG	8,990	9,678	108	11,054	123	11,404	13,373	117
		175,124	161,602	92	156,696	89	194,338	190,353	98
	NIG	5,204	5,053	97	4,975	96	5,834	5,925	102
	NEM	3,379	3,190	94	3,136	93	4,036	4,117	102
	MUN	754	787	104	796	106	962	1,063	110
	FED	1,171	1,264	108	1,225	105	1,536	1,847	120
	CLO	8,233	6,532	79	7,073	86	7,990	8,444	106
	AVON	1,107	1,010	91	887	80	1,269	1,201	95
	BSB	458	448	98	441	96	548	792	145
	US	460	422	92	460	100	545	603	111
	HALX	1,027	1,055	103	1,246	121	1,260	1,468	117
	ANSV	443	329	74	301	68	434	393	91
	NOR	409	406	99	503	123	469	669	143
	Total	197,769	182,098	92	177,739	90	219,221	216,875	99
Pers. Accident	NU	1,253	1,302	104	1,250	100	1,550	1,501	97
	CU	549	774	141	862	157	852	1,122	132
	ROY	720	838	116	857	119	916	1,074	117
	GA	710	754	106	733	103	920	830	90
	GRE	325	504	155	517	159	407	508	125
	SAL	1,191	1,304	110	1,380	116	1,059	1,640	155
	PHX	166	297	179	296	178	208	245	118
	ES	604	536	89	507	84	462	398	86
	PRU	346	359	104	378	109	378	408	108
	COOP	143	148	103	151	106	145	164	113
	LG	28	119	426	155	555	52	337	650
		6,035	6,935	115	7,086	117	6,949	8,227	118
	EXC	502	519	103	588	117	1,057	1,176	111
	CORN	192	143	74	132	69	200	190	95
	MUN	61	171	279	175	285	166	188	113
	PROV	120	153	127	200	166	152	214	141
	NEM	113	147	130	147	131	120	151	126
	Total	7,023	8,068	115	8,328	119	8,644	10,146	117

## GAD database (Base year 1971)

Risk Group	Company	BASIC Chain-ladder Results								
		Provision at end-1975						Provision at end-1976		
		Original assessment Amount £000	Re-assessment at end - 1976		Re-assessment at end - 1977		Original assessment Amount £000	Re-assessment at end - 1977		
			Amount £000	%	Amount £000	%		Amount £000	%	
Fire	NU	6,094	5,634	92	5,281	87	7,139	5,683	80	
	CU	10,641	10,747	101	10,469	98	15,893	13,018	82	
	ROY	13,637	12,139	89	13,818	101	16,421	15,184	92	
	GA	11,103	9,094	82	9,294	84	13,342	11,369	85	
	GRE	10,743	7,532	70	7,581	71	13,063	10,455	80	
	SAL	13,974	12,845	92	13,653	98	25,159	21,469	85	
	PHX	5,316	4,604	87	4,648	87	7,114	6,253	88	
	ES									
	PRU	5,704	5,254	92	5,112	90	6,966	6,963	100	
	COOP	3,650	3,876	106	3,909	107	5,535	6,130	111	
	LG	3,044	3,039	100	2,664	88	4,130	2,755	67	
		83,906	74,764	89	76,429	91	114,762	99,279	87	
	EXC	11,500	14,214	124	13,619	118	16,180	19,476	120	
	FED	500	137	138	85	86	179	117	65	
	PROV	860	973	113	872	101	1,546	1,137	74	
	NEM	1,204	1,449	120	1,704	142	1,691	2,222	131	
	ENN	2,245	2,620	117	2,351	105	2,424	2,527	104	
	AVON	564	668	118	792	140	856	694	81	
	CRU	147	108	73	159	108	131	217	165	
	BRIT	123	56	45	37	30	190	47	25	
	DOM	1,329	1,371	103	1,353	102	2,787	1,813	65	
	MIN	139	102	73	97	69	168	137	81	
	ECON	273	368	135	358	131	418	383	92	
	Total	102,390	96,830	95	97,856	96	141,332	128,049	91	
Empl. Liability	NU	4,285	4,397	103	4,976	116	5,091	5,061	99	
	CU	19,286	18,465	96	18,708	97	20,625	20,544	100	
	ROY	5,624	6,207	110	6,255	111	6,127	6,610	108	
	GA	6,358	7,296	115	6,664	105	8,750	7,755	89	
	GRE	15,405	10,196	66	8,716	57	13,377	10,828	81	
	SAL	6,658	6,663	100	5,743	86	6,598	6,116	93	
	PHX	5,511	5,373	97	4,236	77	5,911	4,446	75	
	ES	39,564	42,795	108	42,745	108	51,728	52,047	101	
	PRU	1,233	1,067	87	1,265	103	1,207	1,428	118	
	COOP	1,165	1,076	92	1,248	107	1,113	1,626	146	
	LG	3,579	3,425	96	3,157	88	4,706	3,513	75	
		108,668	106,960	98	103,713	95	125,233	119,974	96	
	NEM	9,218	9,879	107	8,855	96	11,123	9,484	85	
	ITM	1,036	1,659	160	1,383	134	2,000	1,601	80	
	MUN	5,000	5,371	107	5,191	104	6,632	5,724	86	
	PL	660	546	83	357	54	653	453	69	
	PROV	2,570	2,438	95	2,136	83	2,990	2,492	83	
	TRI	702	225	32	121	17	309	140	45	
	BRIT	35	15	42	27	77	14	30	212	
	AVON	387	377	97	419	108	323	444	137	
	Total	128,276	127,470	99	122,202	95	149,277	140,342	94	

[1080, 600, -432, -208]/25, and the formula is of the fifth degree. The condition for a formula  $[5]^3 10^{-3} [x, y, z, t]$  to be of a lesser degree than five turns out to be the same condition (XY) as for it to be of a lesser degree than four. Thus this class of formula does not contain any fourth-degree osculatory formula, and Jenkins's four-term interpolation formula with second-order contact is of the next class and can be written symbolically as

$$[5]^2 10^{-2} 4 [61, 37, 10, -5, -8, -2]/25.$$

Lastly, let us consider an eight-term interpolation formula for the subdivision of intervals into seven parts based on  $[7]^7 7^{-6} [x, y, z, t, u, v, w]$ . The conditions to be fulfilled, in order that it should be correct to the first, third, fifth and sixth differences, are shown as conditions (AA), (BB), (CC), (DD), respectively, of Appendix D and the conditions that it should have osculatory interpolation of the various orders are shown as conditions (EE), (FF), (GG), (HH), respectively, of Appendix D. They are derived in a like manner to the conditions of Appendix A. Similarly, if conditions (AA), (BB), (CC), (DD) are all satisfied, the end-points will be reproduced. The reproducing interpolation formula with three continuous derivatives, i.e. the solution of the conditions (AA), (BB), (CC), (DD), (EE), (FF), (GG), (HH), yields the nucleus

$$[9345, 7887, -12156, -11409, 14083, -2320, -705]/105,$$

and the graduating interpolation formula correct to fifth differences with four continuous derivatives, i.e. the solution of the conditions (AA), (BB), (CC), (EE), (FF), (GG), (HH), yields the nucleus

$$[216720, 209131, -10061, -411134, 6338, 109475, 5531]/35280$$

with a sixth-difference error of  $29/5040$ .

From Appendix E it may be verified that every interpolation formula derived from  $[7]^8 7^{-7} [x, y, z, t]$  having a sixth-difference error of  $R$  must satisfy the conditions

$$x + 2y + 2z + 2t = 1, \quad y + 4z + 9t = -16,$$

$$z + 6t = 136, \quad t = -5720/7 + 7^6 R.$$

Minimizing the square of the smoothing index based on eighth differences, i.e. minimizing  $x^2 + 2y^2 + 2z^2 + 2t^2$ , we obtain  $R = 65871/11 \cdot 7^7$  and the nucleus  $[6353, 1145, -7234, 2951]/77$  and minimizing the sum of the absolute values of the eighth differences, we obtain  $R = 17944/3 \cdot 7^7$  and the nucleus  $[307, 0, -264, 112]/3$ .

#### REFERENCES

- KARUP (1898). On a new mechanical method of graduation. *Trans. Second Int. Congr. Actu.* London, pp. 78-109, 927-31.  
 SCHÄRTLIN (1888). Die Absterbeordnung der schweizerischen Bevölkerung für die Jahre 1876/77-1880/1. *Z. schweiz. Statist.* Berne, pp. 283-95.  
 MICHALUP (1947). Theorie und Anwendung der oskulatorischen Interpolationsformeln. *Mitt. schweiz. Versich.* Berne, pp. 359-407.  
 MICHALUP (1950). Sobre la Interpolación osculatoria. *Bol. Acad. Cienc. Fis. Mat. Nat.* no. 39, Caracas, pp. 28-75.  
 MICHALUP (1952). New developments in interpolation formulae. *Proc. Int. Congr. Math.* Cambridge, p. 577.

## GAD database (Base year 1971)

Risk Group	Company	INFLATION-ADJUSTED Chain-ladder Results							
		Provision at end-1975					Provision at end-1976		
		Original assessment Amount £000	Re-assessment at end - 1976		Re-assessment at end - 1977		Original assessment Amount £000	Re-assessment at end - 1977	
			Amount £000	%	Amount £000	%		Amount £000	%
Fire	NU	5,808	5,635	97	5,265	91	6,890	5,568	81
	CU	10,615	10,595	100	10,490	99	15,364	12,868	84
	ROY	13,121	11,578	88	13,134	100	15,256	13,969	92
	GA	10,709	8,942	83	9,138	85	12,877	10,973	85
	GRE	10,412	7,339	70	7,415	71	12,789	10,075	79
	SAL	13,769	12,759	93	13,505	98	24,474	20,903	85
	PHX	5,276	4,613	87	4,605	87	6,957	6,112	88
	ES								
	PRU	5,291	4,884	92	4,843	92	6,217	6,412	103
	COOP	3,689	3,859	105	3,869	105	5,431	6,049	111
	LG	3,031	3,025	100	2,673	88	3,974	2,748	69
		81,721	73,229	90	74,937	92	110,229	95,677	87
	EXC	10,850	13,340	123	13,111	121	14,339	18,009	126
	FED	96	131	136	85	89	167	117	70
	PROV	849	955	112	868	102	1,491	1,120	75
	NEM	1,178	1,411	120	1,674	142	1,596	2,120	133
	ENN	2,265	2,534	112	2,303	102	2,266	2,400	106
	AVON	540	652	121	764	141	794	641	81
	CRU	153	108	70	154	100	138	207	150
	BRIT	124	52	42	34	27	196	41	21
	DOM	1,265	1,317	104	1,313	104	2,548	1,717	67
	MIN	143	102	71	96	67	171	135	79
	ECON	279	357	128	355	127	395	368	93
	Total	99,463	94,188	95	95,694	96	134,330	122,552	91
Empl. Liability	NU	3,647	3,897	107	4,549	125	4,292	4,474	104
	CU	17,111	16,580	97	17,743	104	17,656	18,996	108
	ROY	4,821	5,479	114	5,879	122	5,047	6,027	119
	GA	5,250	6,189	118	6,083	116	6,925	6,838	99
	GRE	12,575	9,209	73	8,434	67	11,514	10,439	91
	SAL	5,650	5,745	102	5,377	95	5,377	5,560	103
	PHX	4,461	4,638	104	4,078	91	4,830	4,201	87
	ES	34,589	37,644	109	39,778	115	43,296	47,364	109
	PRU	1,172	1,005	86	1,205	103	1,098	1,333	121
	COOP	1,030	958	93	1,176	114	941	1,484	158
	LG	2,864	2,809	98	2,879	101	3,590	3,140	87
		93,170	94,153	101	97,181	104	104,566	109,856	105
	NEM	7,592	8,581	113	8,376	110	9,128	8,758	96
	ITM	906	1,406	155	1,302	144	1,565	1,464	94
	MUN	4,346	4,715	109	4,892	113	5,539	5,263	95
	PL	535	476	89	355	66	539	445	83
	PROV	2,150	2,033	95	1,957	91	2,355	2,229	95
	TRI	594	248	42	127	21	335	157	47
	BRIT	31	14	44	26	83	15	28	217
	AVON	305	320	105	387	127	259	394	152
	Total	109,629	111,946	102	114,603	105	124,299	128,594	103

NU database (Base year 1970) - BASIC Chain-ladder Results

Risk Group	Company	Reserve multipliers (mean-values)								Reserve amounts based on -				Actual company provision £000	Index corresponding to -			
		Development year								Lowest multipliers £000	Mean value £000	Highest multipliers £000	Lowest		Mean	Highest	Provision	
		0	1	2	3	4	5	6	7									
Private Car	NU	1.42	0.45	0.25	0.12	0.06	0.02	0.01	0.01	12,447	13,861	15,819	16,040	90	100	114	116	
	CU	0.73	0.22	0.13	0.07	0.04	0.02	0.01	0.00	18,513	20,460	23,021	26,741	90	100	113	131	
	ROY	0.27	0.27	0.16	0.08	0.05	0.03	0.01	0.01	14,701	16,197	17,486	21,482	91	100	108	133	
	GA	0.94	0.28	0.17	0.10	0.05	0.03	0.01	0.01	44,931	52,042	59,655	65,700	86	100	115	126	
	GHE	1.08	0.31	0.17	0.09	0.05	0.02	0.01	0.01	31,906	37,223	42,035	31,335	86	100	113	84	
	SAL	1.04	0.31	0.20	0.10	0.05	0.02	0.00	0.00									
	PHX	1.06	0.27	0.16	0.10	0.06	0.02	0.00	0.00									
	ES	1.11	0.34	0.23	0.13	0.07	0.04	0.02	0.01									
	PRU	0.95	0.31	0.19	0.10	0.05	0.02	0.01	0.01									
	COOP	1.17	0.38	0.24	0.15	0.08	0.04	0.02	0.01									
LG	1.47	0.45	0.29	0.17	0.09	0.05	0.01	0.01										
Empl. Liability	NU	27.39	3.04	1.04	0.46	0.22	0.09	0.06	0.05	3,076	3,929	5,072	5,987	78	100	129	152	
	CU	10.32	2.22	0.85	0.37	0.17	0.08	0.04	0.02	23,111	25,821	33,348	31,948	90	100	129	124	
	ROY	23.02	3.09	1.05	0.56	0.34	0.23	0.18	0.12	6,325	7,593	8,483	13,104	83	100	112	173	
	GA	19.52	3.01	1.15	0.61	0.38	0.26	0.16	0.13	6,795	8,885	10,954	16,037	76	100	123	180	
	GHE	18.17	2.06	0.68	0.32	0.13	0.06	0.01	0.00	7,522	12,225	17,991	18,149	62	100	147	148	
	SAL	33.51	4.04	1.43	0.59	0.29	0.16	0.09	0.06									
	PHX	44.00	4.71	1.62	0.74	0.39	0.24	0.16	0.10									
	ES	32.72	3.29	1.21	0.56	0.27	0.14	0.07	0.04									
	PRU	8.24	2.69	1.18	0.64	0.39	0.32	0.28	0.28									
	COOP	26.42	4.74	1.46	0.63	0.29	0.14	0.06	0.02									
LG	48.78	4.88	1.33	0.65	0.31	0.15	0.04	0.04										
Pers. Accident	NU	0.48	0.08	0.04	0.02	0.02	0.01	0.01	0.01	979	1,629	2,025	1,272	60	100	124	78	
	CU	0.53	0.04	0.02	0.01	0.01	0.01	0.01	0.01	629	901	1,130	1,683	70	100	125	187	
	ROY	0.63	0.06	0.02	0.01	0.01	0.01	0.01	0.01	925	1,174	1,383	1,505	79	100	118	128	
	GA	0.60	0.05	0.01	0.01	0.01	0.01	0.01	0.01	645	948	1,179	1,271	68	100	124	134	
	GHE	0.73	0.06	0.02	0.01	0.01	0.01	0.01	0.01	206	372	566	457	55	100	152	123	
	SAL	0.74	0.08	0.02	0.01	0.01	0.01	0.01	0.01									
	PHX	0.61	0.13	0.03	0.01	0.01	0.02	0.01	0.01									
	ES	1.00	0.13	0.04	0.02	0.02	0.01	0.01	0.01									
	PRU	0.44	0.03	0.01	0.01	0.01	0.01	0.01	0.01									
	COOP	0.67	0.05	0.01	0.01	0.01	0.01	0.01	0.01									
LG	0.96	0.07	0.01	0.01	0.01	0.01	0.01	0.01										
Fire	NU	1.32	0.11	0.04	0.02	0.02	0.01	0.01	0.01	2,358	5,889	9,251	14,796	40	100	157	251	
	CU	1.01	0.10	0.04	0.02	0.02	0.01	0.01	0.01	9,484	13,979	19,239	34,073	68	100	138	244	
	ROY	1.33	0.16	0.04	0.02	0.02	0.01	0.01	0.01	10,915	14,871	19,902	28,132	73	100	134	189	
	GA	1.03	0.12	0.03	0.01	0.01	0.01	0.01	0.01	8,324	11,818	15,578	20,122	70	100	132	170	
	GHE	0.84	0.06	0.03	0.01	0.01	0.01	0.01	0.01	9,558	12,282	17,657	28,795	78	100	144	234	
	SAL	1.10	0.12	0.03	0.01	0.01	0.01	0.01	0.01									
	PHX	1.09	0.11	0.04	0.01	0.01	0.01	0.01	0.01									
	ES	1.09	0.12	0.04	0.01	0.01	0.01	0.01	0.01									
	PRU	1.75	0.28	0.09	0.03	0.02	0.02	0.01	0.01									
	COOP	0.49	0.03	0.01	0.01	0.01	0.01	0.01	0.01									
LG	1.94	0.23	0.06	0.03	0.01	0.01	0.01	0.01										



Risk Group	Company	Reserve multipliers (mean-values)								Reserve amounts (zero future inflation) based on -			Reserve amounts (15% p.a. future inflation) based on			Actual Company provision £000	Index corresponding to -			
		Development year								Lowest multipliers £000	Mean value £000	Highest multipliers £000	Lowest multipliers £000	Mean value £000	Highest multipliers £000		Lowest	Mean	Highest	Provision
		0	1	2	3	4	5	6	7											
Private Car	NU	1.04	0.29	0.15	0.06	0.03	0.01	0.00	0.00											
	CU	0.55	0.14	0.07	0.03	0.02	0.01	0.00	0.00											
	ROY	0.67	0.17	0.09	0.04	0.02	0.01	0.00	0.00											
	GA	0.70	0.18	0.10	0.05	0.02	0.01	0.00	0.00											
	GRE	0.82	0.20	0.10	0.05	0.02	0.01	0.00	0.00											
	SAL	0.78	0.19	0.12	0.05	0.02	0.01	0.00	0.00											
	PHX	0.80	0.17	0.09	0.05	0.03	0.01	0.00	0.00											
	ES	0.82	0.21	0.13	0.06	0.03	0.02	0.01	0.00											
	PRU	0.71	0.20	0.11	0.05	0.02	0.01	0.00	0.00											
	COOP	0.85	0.23	0.13	0.07	0.04	0.02	0.01	0.00											
Empl. Liability	LG	1.05	0.27	0.16	0.08	0.04	0.02	0.00	0.00											
	NU	17.83	1.99	0.64	0.27	0.12	0.04	0.03	0.02	1,929	2,427	3,173	3,016	3,795	4,962	5,987	80	100	131	158
	CU	7.09	1.47	0.53	0.22	0.09	0.04	0.02	0.01	15,177	16,893	22,874	23,191	25,813	34,952	31,948	90	100	135	124
	ROY	13.38	1.92	0.60	0.29	0.16	0.10	0.08	0.05	3,657	4,221	4,993	6,374	7,357	8,703	13,104	87	100	118	178
	GA	11.29	1.83	0.65	0.32	0.18	0.12	0.07	0.06											
	GRE	11.93	1.52	0.47	0.20	0.07	0.03	0.00	0.00											
	SAL	20.99	2.66	0.94	0.36	0.16	0.08	0.04	0.03											
	PHX	26.14	2.95	0.98	0.42	0.20	0.12	0.08	0.04											
	ES	21.07	2.17	0.75	0.33	0.15	0.07	0.03	0.02											
	PRU	4.93	1.53	0.63	0.31	0.17	0.13	0.12	0.12											
Pers. Accident	COOP	15.43	3.01	0.91	0.36	0.16	0.08	0.03	0.01											
	LG	30.51	3.23	0.85	0.38	0.16	0.07	0.02	0.02											
	NU	0.39	0.05	0.02	0.01	0.01														
	CU	0.44	0.03																	
	ROY	0.51	0.04	0.01																
	GA	0.50	0.03	0.01																
	GRE	0.56	0.05	0.01																
	SAL	0.58	0.05	0.01																
	PHX	0.46	0.08	0.02	0.01															
	ES	0.83	0.10	0.02	0.01	0.01	0.01													
Fire	PRU	0.36	0.02	0.01																
	COOP	0.58	0.04																	
	LG	0.60	0.04																	
	NU	1.10	0.09																	
	CU	0.87	0.08																	
	ROY	1.11	0.11	0.02	0.01	0.01														
	GA	0.86	0.09	0.02	0.01															
	GRE	0.74	0.05																	
	SAL	0.92	0.09	0.02																
	PHX	0.92	0.08	0.01																
ES	0.93	0.09	0.03																	
PRU	1.37	0.20	0.06	0.01	0.01	0.01	0.01													
COOP	0.41	0.03	0.01																	
LG	1.60	0.19	0.05	0.02	0.01															

1979 DoT Annual Returns Working Party

Chain-Ladder Calculations

J.E.Lockett

1. Objectives

- 1.1 This paper aims to focus attention on the sizes and variations in sizes, of the parameters used in chain-ladder calculations of claims reserves.
- 1.2 In an ideal world, one might hope to be able to find patterns of suitable stable parameters which might be used over a fairly wide range of accounts of a specific type for the majority of companies over several years. These would, of course, be of particular use to those responsible for carrying out checks (external to each company) as to the adequacy of the reserves set up.

An attempt is made here to indicate the levels of factors apparently required for use in chain-ladder calculations. A start is also made on the analysis of the extent of variations to be expected in these factors between companies and within a particular account.

2. Source of data

- 2.1 Investigations have been carried out on three classifications of business -

Motor vehicle : Employers Liability : Property, Fire.

The claims payment data published in Schedule 3 part III of the statutory DoT returns from a selection of companies is the basis for this paper.

- 2.2 The GAD database has been used to provide information under each classification for a selection of companies which cover the range of size of (UK) operation in each category. The same companies are not all used for every category. The database starts with year 1971, and all selected companies have provided returns for every year 1971-7.

3. Outline of the Investigations

- 3.1 The computer programs have produced the chain-ladder triangle multipliers for the two variations of chain-ladder calculations which may be referred to as -

- (a) the 'basic' method using past claims payments without adjustment,
- (b) the 'inflation-adjusted' method in which amounts of past payments were first adjusted to money values at the end of 1977.

Estimates of the total outstanding claims can then be made using various assumptions based on these tables of multipliers.

- 3.2 There are differences between companies within class as regards both the actual nature of business accepted, and the office procedures for dealing with claims, which will affect claim payment patterns. Indeed changes in acceptances and/or claims procedures may occur intentionally or otherwise within a company during the period under review in the calculations. Given only the data in the DoT returns, information on such differences or changes is not available, although some background knowledge of a company will be available to most observers. The effects on the multipliers can be readily seen though.

The volume of business of each class written by any company may not in itself influence the underlying claim payment pattern, but it affects the extent of variability of parameters which should be expected between years within companies.

- 3.3 To illustrate the extent of variations in the multipliers relevant to the points in 3.2, the average factors outstanding/paid to date applicable for each company on each calculation basis are presented. The ratio of the largest to the smallest of the factors which might have been extracted from the triangle of past values to apply to end-of-first-development-year claims is given for each company on each basis. Also comparisons of the total outstanding at end-1977 for all years of origin 1972 to 1977 calculated on various assumptions are given for each company using the 'inflation-adjusted' method.

- 3.4 In the 'basic' method of calculation no adjustment for inflation is made and so variations will arise as inflation rates change. Even when the 'inflation-adjusted' method is used it is not always obvious what rates of inflation should be built in. The significance, in terms of the total outstanding claims estimates, of changes in rates of future inflation assumed are indicated.

#### 4. Some observations based on the tables

##### 4.1 Table 1 - Motor vehicles. Columns 1-8

As expected variability in the multipliers (reflected by the values in columns 4 and 8) tends to be larger for the smaller portfolios. Although values in columns 5 and 6 are generally markedly lower than those in columns 1 and 2 respectively, those in column 8 are not much different from those in column 4 with only a tendency for them to be lower in most cases. Thus regarding variability or consistent features in the multiplier values, there does not seem to be any particular advantage in method (b) over method (a).

##### 4.2 Table 2 - Fire. Columns 1-8

No clear pattern seems to emerge from the figures in columns 1-4 or 5-8. Also there does not seem to be a strong connection between the sizes of the two sets of figures (although the second is usually lower than the first), which might indicate that the adjustments made to allow for past inflation in method (b) may not be fully appropriate to all the data.

##### 4.3 Table 3 - Employers Liability

Values in column 1 are very high and vary widely. Values in columns 2 and 3 are also high. Despite this, values in column 4 are not much higher than for Fire. Figures in columns 5, 6, 7 and generally about  $\frac{2}{3}$  those in columns 1, 2, 3 respectively, but there seems to be no obvious relationship between those in columns 4 and 8, so perhaps the adjustments for past inflation in method (b) are not fully appropriate.

Surprisingly the values in column 9 are fairly small (slightly lower than for fire accounts of similar size). Values in columns 10 and 11 are stable and only slightly higher than for motor.

#### 4.4 Tables 1, 2 and 3 - Columns 9-12

The same comments appear to apply to all three classes here. Figures in columns 10 and 11 seem to be remarkably steady for each class. Column 11 is probably the better indicator as, although it may be difficult to judge suitable inflation rates for the full number of years required, it is usually relatively easy to decide on an appropriate rate for the forthcoming year. Bearing in mind the large differences in rates used in these examples, comparisons with values in column 9 indicate that a small change in the rate of future inflation assumed will prove to be relatively unimportant compared with changing assumptions in the choice of multipliers to be extracted from the underlying development triangle. Values in column 12 are also fairly stable and seem to indicate that use of the unadjusted method (a) at end 1977 was broadly comparable for all 3 classes with using method (b) with assumed future inflation of about 16-17% per annum.

Key to columns in tablesCompany and size.

The size is indicated for the relevant account of each company by the NWP for the appropriate main class group as given in the 1976 DoT return (£ millions). The main class is not always the best guide for the classification investigated, but is used here as being the most conveniently available indicator. Companies are shown in an order to give the 11 large companies referred to in the associated papers from this research group in a similar order at the top of each table (where figures were available). Thereafter companies appear in decreasing size indicator order.

(a) Basic method

The figures in these columns arise from the basic development triangle of factors. For columns 1, 2, 3 the average factor for each column in the triangle was first calculated.\*

Column 1. By combining the average factors, the factor to be applied to the end of first-year-of-development claims to obtain an estimate of outstanding claims for that one (latest) year of origin.

Column 2. As for 1, but the factor applicable to end of second-year-of-development claims.

Column 3. As for 1, but the factor applicable to end of third-year-of-development claims.

\*For motor and fire it seems reasonable to assume that payments after year-of-development 7 will be negligible, and hence that the data available gives a complete development triangle (even though it is appreciated that further data would give more confidence in the values in the extreme corner). For employers liability, it has been necessary to assume in this presentation that there will be negligible development after year 7 since there is no available data beyond this time, although it is appreciated that this is not likely to be the case in many accounts and that longer development tracking is really required to give a better indication of ultimate development. Thus the factors given in columns 1, 2 3 are to this extent inaccurate and those in column 4 will be too small, particularly for EL.

Column 4. Firstly the largest value in each column of the basic development triangle was extracted, then the smallest value in each column extracted. (There seemed to be no pattern as to whether large or small values appeared in the same line of the triangle except for a few accounts, where special knowledge of the company might have given explanation.) The largest values were combined to given an end-of-first-year-of-development factor (cf. column 1) and the smallest values were similarly combined. The largest first year factor thus calculated is finally divided by the smallest first year factor to indicate the maximum variability possible in the factor applicable to the latest year of origin claims.

(b) Inflation-adjusted method

The figures in these columns arise from the development triangle of factors derived from payments which had been adjusted to eliminate the effects of past inflation. No amendments are made at this stage to allow for assumed rates of future inflation, and so if these values were to be used in calculations an implicit 0% future inflation would be assumed.

Columns 5, 6, 7, 8 correspond with columns 1, 2, 3, 4 respectively.

(c) Ratios of totals estimated outstanding at 31st December 1977

For each of columns 9, 10, 11, 12 two calculations of the total outstanding claims for all years of origin 1972-7 for each account were made using different development factors and/or future inflation assumptions. The ratio of the two answers are shown here. (Ratio answer basis A to answer basis B.)

Column 9. A uses inflation-adjusted triangle, largest factor from each column, 0% future inflation.

B uses inflation-adjusted triangle, average factor from each column, 0% future inflation.

Column 10. A uses inflation-adjusted triangle, average factors, 15% future inflation (Motor, EL) but 8½% for one year then 12½% for fire.

B uses inflation-adjusted triangle, average factors, 0% future inflation (all).

Column 11. A uses inflation-adjusted triangle, average factors, future inflation 5% for one year then 15% thereafter (all).

B uses inflation-adjusted triangle, average factors, future inflation 5% throughout.

Column 12. A uses basic unadjusted triangle, average factors.

B uses inflation-adjusted triangle, average factors, 15% future inflation (Motor, EL) but 8½% for one year then 12½% for Fire.

TABLE 1

## MOTOR VEHICLES

Company	Size	Basic method				Inflation-adjusted method				Ratios of totals estimated o/s at end 1977			
		1	2	3	4	5	6	7	8	9	10	11	12
NU	42.7	1.43	.45	.25	1.42	1.04	.30	.15	1.38	1.22	1.39	1.15	1.03
CU	64.3	.70	.20	.12	1.34	.53	.13	.07	1.40	1.21	1.28	1.12	1.05
ROY	88.5	.88	.27	.16	1.32	.66	.17	.09	1.34	1.18	1.34	1.14	1.04
GA	200.1	.92	.26	.15	1.44	.69	.17	.08	1.38	1.16	1.34	1.13	1.04
GRE	90.7	1.06	.29	.16	1.58	.80	.19	.09	1.49	1.13	1.30	1.14	1.04
SAL	50.7	1.05	.31	.20	1.32	.77	.19	.11	1.22	1.11	1.36	1.15	1.04
PHX	10.7	1.09	.30	.18	1.52	.80	.18	.09	1.31	1.20	1.32	1.14	1.04
ES	47.5	1.08	.33	.21	1.40	.79	.20	.12	1.46	1.18	1.35	1.15	1.05
PRU	67.6	.94	.31	.18	1.37	.70	.20	.11	1.37	1.20	1.34	1.14	1.05
L & G	18.1	1.52	.47	.30	1.44	1.07	.28	.16	1.45	1.19	1.53	1.17	1.00
NIG	15.0	1.05	.28	.16	1.30	.79	.19	.09	1.36	1.16	1.35	1.12	1.02
NEM	14.8	.82	.20	.13	1.52	.62	.12	.07	1.47	1.32	1.36	1.13	1.03
MUN	10.5	.61	.12	.06	1.56	.49	.08	.03	1.67	1.44	1.24	1.08	1.05
FED	4.8	1.08	.28	.16	2.19	.82	.18	.09	2.19	1.47	1.31	1.13	1.05
CLOV	4.4	2.27	.48	.20	2.47	1.74	.35	.13	2.30	1.45	1.26	1.10	1.05
AVON	3.0	1.02	.29	.22	1.85	.76	.18	.13	1.72	1.40	1.36	1.14	1.03
BSB	2.1	1.09	.28	.14	3.79	.85	.19	.09	3.67	2.08	1.26	1.11	1.04
UNST	1.5	.82	.17	.08	1.99	.66	.12	.05	1.84	1.41	1.42	1.08	.97
HAL	1.4	1.70	.57	.30	2.07	1.22	.37	.18	1.92	1.45	1.32	1.16	1.06
ANSV	.9	1.00	.33	.19	2.44	.77	.23	.13	1.99	1.41	1.30	1.15	1.06
NORM	.8	.94	.27	.16	2.50	.71	.18	.09	2.38	1.57	1.39	1.12	1.02

TABLE 2

Company	Size	Basic method				Inflation-adjusted method				Ratios of totals estimated o/s at end 1977			
		1	2	3	4	5	6	7	8	9	10	11	12
NU	31.7	1.28	.09	-.02	2.80	1.10	.08	-.01	2.18	1.50	1.08	1.03	1.05
CU	94.0	.98	.09	-	1.80	.84	.08	-	1.57	1.33	1.09	1.03	1.07
ROY	142.5	1.36	.15	.03	2.22	1.14	.11	.02	1.86	1.43	1.19	1.05	1.06
GA	132.9	1.06	.11	.03	1.86	.88	.08	.02	1.64	1.27	1.14	1.04	1.07
GRE	78.0	.84	.05	-.02	1.89	.73	.04	-.01	1.78	1.36	1.11	1.02	1.04
SAL	122.0	1.12	.11	.01	1.88	.95	.09	.01	1.71	1.36	1.12	1.04	1.07
PHX	14.4	1.07	.09	-	2.17	.91	.08	-	1.79	1.41	1.11	1.03	1.06
PRU	61.7	1.74	.27	.08	2.32	1.40	.20	.05	1.92	1.43	1.20	1.08	1.08
COOP	26.7	.51	.04	.02	1.55	.43	.03	.01	1.38	1.28	1.13	1.05	1.07
L & G	29.0	1.93	.20	.03	3.13	1.62	.17	.03	1.28	1.72	1.12	1.06	1.07
PROV	10.7	.67	.05	-	2.11	.57	.04	-	1.82	1.46	1.12	1.02	1.06
NEM	6.9	1.02	.12	.03	2.41	.84	.09	.02	2.17	1.45	1.13	1.05	1.09
ENN	3.9	2.93	.48	.14	4.83	2.31	.36	.09	5.18	1.62	1.18	1.12	1.08
AVON	3.4	1.73	.20	.08	4.51	1.41	.14	.05	3.68	1.89	1.13	1.07	1.09
CRU	2.8	.55	.03	.01	4.54	.47	.02	.01	6.00	3.70	1.11	1.02	1.06
BRIT	2.7	1.35	-	-.03	13.18	1.22	.01	-.01	11.74	2.66	1.12	1.01	1.03
DOM	1.7	3.19	.45	.18	3.23	2.50	.33	.12	3.27	1.55	1.19	1.11	1.09
MIN	1.4	.91	.09	.03	2.17	.77	.06	.02	2.33	1.55	1.11	1.06	1.06
ECON	1.0	1.82	.26	.07	3.08	1.48	.19	.04	3.00	1.67	1.13	1.06	1.08
FED	.6	.61	.03	.01	3.89	.52	.02	.01	4.12	1.94	1.10	1.03	1.06



## EMPLOYERS LIABILITY

TABLE 3

Company	Size	Basic method				Inflation-adjusted method				Ratios of totals estimated o/s at end 1977			
		1	2	3	4	5	6	7	8	9	10	11	12
NIJ	9.5	29.35	2.92	.98	3.08	19.27	1.98	.64	2.75	1.38	1.42	1.17	1.04
CU	36.4	9.81	2.13	.80	1.56	6.59	1.43	.52	1.57	1.19	1.39	1.19	1.05
ROY	53.2	21.63	2.53	.79	2.25	7.41	1.74	.52	2.26	1.25	1.39	1.17	1.05
GA	45.5	17.45	2.38	.83	2.68	11.67	1.62	.54	2.38	1.45	1.45	1.18	1.04
GRE	19.3	23.31	2.32	.76	3.88	15.55	1.57	.50	2.88	1.49	1.40	1.19	1.06
SAL	29.2	30.63	3.41	1.11	2.63	20.13	2.33	.75	2.49	1.34	1.42	1.18	1.04
PIX	4.8	39.83	4.02	1.34	2.30	25.21	2.66	.88	2.07	1.27	1.41	1.21	1.07
ES	44.7	30.98	3.05	1.08	1.38	20.25	2.06	.71	1.52	1.16	1.44	1.20	1.04
PRU	15.6	6.46	2.02	.73	2.62	4.37	1.37	.48	2.46	1.38	1.37	1.18	1.05
COOP	2.8	26.42	4.29	1.31	5.93	17.03	2.90	.89	5.89	1.85	1.38	1.20	1.07
L & G	13.1	55.35	5.23	2.39	3.61	33.96	3.43	.88	3.05	1.43	1.52	1.24	1.05
NEM	36.0	19.97	2.52	1.03	2.20	12.83	1.66	.62	1.87	1.28	1.43	1.20	1.06
MUN	12.3	16.76	3.34	1.08	2.43	10.96	2.26	.72	2.27	1.29	1.41	1.24	1.06
PROV	5.3	32.50	3.71	1.40	3.99	20.35	2.40	.89	3.56	1.44	1.48	1.21	1.03
IT	2.1	22.86	2.91	1.13	3.24	15.00	1.97	.75	2.78	1.46	1.40	1.18	1.06
PRL	2.0	26.79	3.21	.92	6.56	17.92	2.24	.64	4.77	2.09	1.32	1.20	1.08
AVON	.5	70.52	7.80	3.08	79.60	40.68	4.75	1.94	54.56	3.65	1.44	1.23	1.11
BRIT	.3	15.08	1.42	.97	229.74	10.04	.90	.60	135.29	2.93	1.31	1.10	1.08
TRID		48.47	4.41	.72	115.43	32.15	3.29	.54	79.72	6.83	1.35	1.18	1.06

# 1979 DOT ANNUAL RETURNS WORKING PARTY

## STANDARD TABLES BASED ON DOT RETURNS DATA

1. Actuaries in life assurance play an important role in relationships between the industry and the supervisors. This role is based on the existence of methods and bases of control which are generally accepted within the profession and which the supervisory authority accepts as being suitable for monitoring the industry.

The purpose of this paper is to highlight some of the problems involved in producing corresponding methods and bases in relation to assessing reserves in General Insurance by considering the statistical information produced in the DOT returns. In particular the paper considers the feasibility of using the data in the DOT returns to produce 'standard tables' to model claims run-offs.

2. The fundamental problem is to estimate the underlying pattern of claims run-off in a stable situation and this is considered in Section 4 below. This is necessarily based on historical data after allowing as far as possible for such unstabilizing influences as changes in inflation rates, changes in speed of settlement, changes in mix of business and large claims. Several papers have been written in recent years on possible methods of attempting to allow for these factors. [See Bibliography]

In order to estimate the reserves required further assumptions would have to be built on to this basic model. The most important in current conditions is the assumed rate of future inflation but in addition, and depending upon the purpose of the estimate, assumptions might be needed for future interest rates, fluctuation margins, large claims, taxation and expenses. Whilst these are clearly important elements in any 'actuarial basis' for examining and projecting claims data they are not considered further in this paper which is restricted to examining the data in the Schedule 3 statistical returns.

3. The data base used to produce the Tables in the Appendix consisted of the Schedules 3 Part III returns from 1971-77 in respect of 76 risk groups: 21 Private Car; 15 Personal Accident; 19 Employers Liability; 21 Property Fire.

### 4. STANDARD TABLES?

4.1 Tables 1 to 4 show the cumulative proportion of claim payments by development year. The figures were calculated using the unadjusted chain ladder method and the cumulative proportions are the inverse of the usual grossing up factors. Similar factors were calculated using the inflation adjusted chain ladder method but there was no significant change in the overall pattern of results.

4.2 In all the Tables the range of factors at any particular duration is very large. One reason for this, especially in the case of Employers Liability but also in Private Car, is the wide variation between companies in the proportion of claims estimated as still outstanding after year 7. This problem of the tail of the distribution is considered in more detail in Section 5.

One further factor which may affect any inter-company comparison is the possibly different nature of business included within the defined risk groups. As each company is responsible for deciding upon the definition and nature of the risk groups in its returns there is inevitably some lack of consistency within a risk classification. In addition, even if the

definitions coincide, the mix of business within the risk group may vary eg the proportion of non-comprehensive motor business in the Private Car account will vary. As a result the underlying cumulative proportions will differ. If there is to be any hope of providing standard tables then it appears that a tighter definition of risk categories is required. There would however be problems over maintaining homogeneity at the same time as keeping the number of risk groups to a manageable size and the amount of business in each risk group significant.

4.3 To illustrate the effect of variations between a standard model and an individual company's experience suppose the standard bases were as follows:

#### CUMULATIVE PROPORTIONS OF CLAIM PAYMENTS

Risk Group	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
EL	.05	.25	.46	.66	.81	.89	.94	1.00
MV	.47	.75	.83	.90	.94	.96	.97	1.00
PF	.44	.86	.94	.98	.99	1.00		
PA	.57	.91	.97	.98	.99	1.00		

These proportions are roughly the same as the means from Tables 1 to 4.

If an individual company has a claims run-off which is one percentage point lower at each duration than the above then assuming a steady state with ultimate claims of 100 in each cohort the actual and projected outstandings would be

RISK GROUP	<u>Actual Outstandings</u>	<u>Projected Outstandings</u>
EL	96+76+55+35+20+12+7 = 301	76+72+53+33+19+11+6 = 270
MV	54+26+18+11+7+5+4 = 125	52+25+17+10+6+4+3 = 117
PF	57+15+7+3+2 = 84	55+14+6+2+1 = 78
PA	44+10+4+3+2 = 63	42+9+3+2+1 = 57

The percentage error in the projection varies from 6% in the Fire risk group to 10% in the Employers Liability. If we assume that annual premium income in each risk group of the order of 150 then, as a percentage of the premium income, the error varies from 4% for Personal Accident to 21% for Employers Liability. The latter is very large in comparison with the sort of margins companies maintain over the statutory solvency margin.

If the company's run-off is two percentage points lower than the model at each duration then the error increases to 20% of the outstandings for Employers Liability. This would be about 40% of the statutory solvency margin

4.4. Tables 1 to 4 suggest that the variation in practice is likely to be even greater than in this simplified example so that standard tables based on the data in the DOT returns would prove unsatisfactory.

## 5. THE TAIL OF THE RUN-OFF DISTRIBUTION

5.1. This is essentially the extreme case of the basic problem of modelling run-offs as the tail of the run-off is usually the most variable part. This arises for two reasons. Firstly, the number of claims involved is small and very variable as can be seen from Cols (1) to (3) of Tables 5 and 6. Secondly the variance of the individual claim size in the tail is extremely high. These features make it extremely difficult for simple statistical methods to produce satisfactory results.

5.2 Historically, the problem of the 'tail' in analysing the information in the DOT returns first arose as the data was only submitted for years of origin from 1970 onwards. Thus in the early years no information was available on the tails of the distributions apart from the companies' own estimates. As a result any calculations based on the DOT returns had to make some fairly arbitrary assumptions on the tail. The conventional assumption was that a company's estimate for the earliest year of origin was correct. This implied not only that the earliest year's run-off would accord with the company's estimate but also that on average a similar relationship between outstandings and paid at that duration would recur on average in subsequent years. Tables 5 and 6 give an indication of the variability of the proportion of claims settled after year 5 both by number and amount and suggest that the use of the company's estimate for the earliest year would be very unreliable.

5.3 The possible extreme effect of this variability can be seen from the example in Table 7 which is based on an actual U.K. Private Car Account. The illustration uses the unadjusted chain ladder method but any method relying upon grossing up for the tail using the first year of origin would produce similar results.

5.4 The calculations produce estimates of the claims outstanding at 31.12.77 for years of origin 1972-77. Based on the data from 1971 the suggested figure is £17.3m while based on data from 1972 the figure is £9.6m. If the 'pole' factors are ignored the 1971 based estimate is £10.0m and the 1972 £8.3m although it should be noted in this case that the latter involves one years less development.\*

5.5 It is interesting to note what may be called the gearing effect of the assumption of the tail run-off on the overall estimate. For the 1971 base the tail factor increases the base year from £2.324m to £2.780m ie an increase of 19.6%. This produces an increase of 72.1% in the projected total outstandings. For the 1972 base the corresponding figures are 4.2% and 16.7%.

5.6 The data available in the returns from 1971-77 is still insufficient to provide an adequate basis for analysing the variability in the tails and examining the merits of possible ways of dealing with the problem. However the general extent of the problem can be seen from Tables 5 and 6 which show the position at the end of year 5 of development. The figures are based on the companies' estimates of outstandings at that date and while there will be some amendment to the estimates during the later run-off this is unlikely to have a material effect on the position. Again there is wide variation between the experience of different companies. As far as can be told at present with the limited data, there is also a substantial variation from year to year for an individual company.

\* The 'pole' factor in Table 7 is the ratio of claims paid plus outstanding estimates to claims paid for the earliest year of origin of the relevant run-off.

5.7 There are a number of possible methods which could be used to project the tail other than the simple method in Table 7.

Firstly, as a minor amendment to the basic method, the tail could be estimated by averaging a number of the earliest years of origin. This could, for example, be done by curtailing the triangle after a fixed number of years' development and the 'pole factor' being then derived from the company's estimates for the cut-off years. The general effect of this would clearly be to average out any unusual features in the outstanding claims of what is, by chance, the base year of the data. In the longer term as full run-offs are available for several years of origin this method, as for the simpler one, would use the full run-offs to produce the estimate.

Secondly, a simple general model can be used to estimate the tail. The use of a negative exponential run-off was suggested by Beard [1974]. There would remain the practical problem of determining the constant rate of run-off from data subject to substantial variation.

5.8 Both of these methods are based on projecting 'average' tails. They would therefore produce unsatisfactory estimates at any time when the overall outstandings depart materially from this average. This would be expected to occur frequently when only small amounts of business are involved. Indeed it is questionable whether any averaging method is satisfactory for the 'tail' of the run-offs when applied to the DOT data.

There are a number of possible ways in which this position might be improved although, in the absence of suitable available data for checking, these are merely suggestions.

Firstly if data were available net of reinsurance the effect of large claims would be reduced by any excess of loss reinsurance. The problem of interpreting the effect of changes in reinsurance arrangements would be introduced but in practice this is likely to be of less significance. Indeed as most analyses of the Schedule 3 returns will be ultimately concerned with the net position the problem of interpreting the effect of reinsurance already exists and would simply be introduced in a different, and possibly more manageable, way.

Alternatively if information is provided on the size of actual large claim both in the past figures and anticipated in the outstandings then they could be assessed separately from the statistical exercise on the bulk of the run-off.

## 6. Conclusion

The data in the DOT returns is an unsatisfactory basis from which to attempt to identify 'standard tables'. Indeed the inherent variability in run-offs suggests that standard tables in any simple format may be unattainable.

A.G. Young

JUNE 1979

TABLE 1 EMPLOYERS LIABILITY  
CUMULATIVE PROPORTION OF CLAIM PAYMENTS

Company	Development year	1	2	3	4	5	6	7	Ultimate
E.S.		.029	.224	.434	.613	.755	.851	.906	1.000
C.U.		.089	.305	.529	.719	.844	.919	.957	1.000
ROY		.041	.264	.522	.691	.814	.882	.935	1.000
S.A.L.		.030	.207	.433	.649	.794	.851	.903	1.000
N.E.M.		.045	.267	.467	.617	.717	.844	.931	1.000
G.A.		.047	.256	.477	.639	.754	.835	.867	1.000
CO-OP		.038	.186	.424	.652	.854	.947	.974	1.000
PRU		.133	.327	.558	.743	.881	.942	.961	1.000
G.R.E.		.043	.309	.561	.716	.837	.887	.961	1.000
IRONT		.038	.232	.428	.688	.816	.878	.933	1.000
L&G		.016	.138	.351	.488	.627	.728	.858	1.000
MUN		.055	.215	.451	.675	.830	.914	.947	1.000
N.U.		.030	.224	.446	.631	.748	.853	.876	1.000
PEARL		.039	.258	.559	.832	.952	.973	.999	1.000
PHO		.024	.193	.417	.630	.792	.906	.970	1.000
PROV		.026	.180	.353	.519	.654	.728	.851	1.000
TRID		.040	.252	.507	.810	.968	.982	.989	1.000
BRIT		.092	.499	.583	.670	1.000	1.000	1.000	1.000
AVON		.022	.123	.262	.491	.770	.905	.955	1.000
MEAN		.046	.245	.461	.656	.811	.886	.935	
MAXIMUM		.133	.499	.583	.832	1.000	1.000	1.000	
MINIMUM		.016	.123	.262	.488	.627	.728	.851	

TABLE 2 MOTOR PRIVATE CAR

## CUMULATIVE PROPORTION OF CLAIM PAYMENTS

Company	Development year	1	2	3	4	5	6	7	Ultimate
NU		.392	.654	.760	.851	.900	.935	.948	1.000
CU		.587	.833	.893	.944	.975	.995	.998	1.000
ROYAL		.519	.775	.847	.907	.940	.960	.982	1.000
GA		.511	.778	.851	.905	.939	.964	.979	1.000
GRE		.484	.771	.859	.922	.964	.984	.988	1.000
SAL		.477	.747	.814	.885	.926	.960	.977	1.000
PIO		.477	.772	.850	.891	.928	.972	.996	1.000
ES		.474	.740	.810	.880	.930	.961	.983	1.000
PRU		.507	.753	.834	.898	.946	.973	.985	1.000
L&G		.333	.568	.642	.710	.760	.790	.836	1.000
NIG		.471	.751	.835	.900	.936	.954	.963	1.000
NEM		.534	.810	.862	.902	.933	.956	.969	1.000
MUN		.612	.886	.941	.962	.990	1.000	1.000	1.000
FED		.470	.772	.850	.908	.955	.982	.993	1.000
CLOV		.312	.653	.822	.943	1.000	.989	.992	1.000
AVON		.482	.759	.804	.903	.937	.952	.976	1.000
BS&B		.457	.804	.896	.962	.991	.996	1.000	1.000
US		.502	.779	.849	.893	.908	.913	.914	1.000
HAL		.369	.630	.768	.885	.924	.980	1.000	1.000
ANS		.505	.758	.844	.915	.972	.998	1.000	1.000
NOR		.488	.743	.814	.889	.925	.932	.944	1.000
MEAN		.474	.749	.831	.898	.937	.959	.973	
MAXIMUM		.612	.886	.941	.962	1.000	1.000	1.000	
MINIMUM		.312	.568	.642	.710	.760	.790	.836	
MINIMUM(Excl. L&G)		.312	.630	.760	.851	.900	.932	.944	

TABLE 3 PROPERTY FIRE

## CUMULATIVE DISTRIBUTION OF CLAIM PAYMENTS

Company	Development Year	1	2	3	4	5	6	7	Ultimate
ROY		.411	.858	.933	.958	.951	.966	.970	1.0
GA		.486	.891	.965	.984	.990	.992	.993	1.0
SAL		.473	.892	.978	.998	.999	.997	.996	1.0
CU		.505	.913	1.001	1.014	1.008	1.000	1.001	1.0
GRE		.546	.939	1.003	1.009	.998	.988	.986	1.0
PRU		.345	.757	.887	.941	.951	.952	.963	1.0
NU		.430	.903	1.008	1.016	1.013	1.008	.992	1.0
L&G		.345	.836	.974	.990	1.016	.998	.997	1.0
COOP		.658	.959	.981	.987	.987	.997	.998	1.0
PHO		.479	.908	.994	1.006	1.006	1.000	.993	1.0
EXC		.144	.519	.767	.911	.960	.974	.980	1.0
FED		.630	.969	.989	.993	.994	.999	1.000	1.0
PROV		.602	.952	.996	.998	.993	.994	.996	1.0
NEM		.482	.877	.960	.984	.990	.994	.998	1.0
ENN(UK)		.298	.670	.867	.944	.968	.977	.985	1.0
AVON		.369	.813	.912	.940	1.019	1.021	.997	1.0
CRU		.653	.960	.972	1.003	.995	.995	.995	1.0
BRIT		.468	.959	.985	.993	.993	1.003	.960	1.0
DOM		.250	.695	.842	.926	.957	.974	.987	1.0
MIN		.531	.920	.968	.992	1.006	1.002	.999	1.0
ECO		.368	.803	.940	.989	.995	.998	1.000	1.0
MEAN		.436	.855	.949	.980	.990	.992	.990	
MAXIMUM		.658	.969	1.0	1.0	1.0	1.0	1.0	
MINIMUM		.144	.519	.767	.911	.951	.952	.960	



TABLE 4 PERSONAL ACCIDENT

## CUMULATIVE DISTRIBUTION OF CLAIM PAYMENTS

Company	Development Year	1	2	3	4	5	6	7	Ultimate
NU		.667	.911	.943	.959	.964	.967	.970	1.0
CU		.649	.962	1.004	1.005	1.000	1.000	1.000	1.0
ROY		.611	.945	.983	.991	.995	.997	.998	1.0
GA		.617	.954	.990	.994	.996	.996	.999	1.0
GRE		.557	.938	.985	.995	1.000	1.000	1.000	1.0
SAL		.574	.929	.980	.995	.999	.999	1.000	1.0
PHO		.611	.880	.970	.989	.995	.998	.999	1.0
ES		.506	.907	.978	.996	.995	.999	.999	1.0
PRU		.694	.972	.991	.995	.996	.997	.999	1.0
L & G		.495	.930	.993	.993	1.000	1.000	1.000	1.0
EX		.225	.624	.797	.859	.918	.939	.944	1.0
CORN		.711	.952	.978	.992	.999	1.000	1.000	1.0
MUN		.499	.925	.982	.989	1.000	1.000	1.000	1.0
PROV		.592	.893	.943	.963	.997	.998	.999	1.0
NIM		.544	.950	.991	1.000	1.000	1.000	1.000	1.0
NEAN		.570	.911	.967	.981	.991	.993	.994	
MAXIMUM		.711	.972	1.	1.	1.	1.	1.	
MINIMUM		.225	.624	.797	.859	.918	.939	.944	
MINIMUM(excl EX)		.495	.880	.943	.959	.964	.967	.970	

TABLE 5. EMPLOYER'S LIABILITY

Company	% by number of claims still outstanding at end of year 5 for year of origin			% by amount of claim settlements still outstanding at end of year 5 for year of origin			% by amount of claim payments still outstanding at end of year 5 for year of origin		
	1971	1972	1973	1971	1972	1973	1971	1972	1973
ES	5.9	6.6	6.4	27.5	31.6	31.2	19.4	24.0	24.7
CU	2.7	2.8	2.7	23.8	25.4	26.5	15.8	19.5	20.0
ROY	1.9	2.3	2.4	27.8	23.8	29.8	23.3	21.5	25.0
SAL	1.2	1.3	1.7	31.6	30.2	34.2	25.0	20.1	24.8
NEM	2.5	3.5	4.0	33.0	29.1	27.3	28.8	23.0	20.9
GA	2.2	1.9	1.7	30.9	35.4	24.5	29.1	28.5	23.0
COOP	1.7	1.3	1.9	21.0	34.0	28.3	20.1	31.5	19.0
PRU	0.8	1.6	1.5	13.9	24.3	28.6	7.9	16.7	14.2
GRE	1.9	1.3	1.3	25.5	20.7	12.8	18.6	12.8	11.2
IRON	7.8	5.8	6.3	33.3	35.1	37.7	20.8	24.6	30.5
L&G	4.8	5.9	5.5	48.2	42.2	36.3	43.8	27.2	31.7
MUN	3.4	2.5	4.2	28.1	24.2	31.8	21.0	18.7	28.4
NU	1.8	1.9	2.5	27.9	25.0	25.8	18.8	20.9	15.4
PEARL	4.5	4.7	4.9	33.0	42.6	43.3	12.5	14.8	23.4
PHO	3.3	2.9	2.7	33.3	28.8	25.5	29.2	23.1	19.6
PROV	4.2	3.9	3.7	38.9	37.0	34.5	36.8	33.7	24.3
TRID	3.5	6.7	5.4	65.2	39.0	41.7	1.1	34.6	26.3
BRIT	1.7	0.0	3.5	00.1	0.0	72.6	0.0	0.0	72.7
AVON	5.7	4.8	7.6	44.8	38.9	78.6	43.7	31.9	33.5

TABLE 6 MOTOR

Company	% by number of claims still outstanding at end of year 5 for year of origin			% by amount of claim settlements still outstanding at end of year 5 for year of origin			% by amount of claim payments still outstanding at end of year 5 for year of origin		
	1971	1972	1973	1971	1972	1973	1971	1972	1973
NU	0.27	0.25	0.21	17.25	14.24	11.49	10.73	7.29	6.90
CU	0.15	0.15	0.14	7.89	9.50	6.92	3.24	4.81	3.36
ROY	0.33	0.22	0.33	11.42	9.42	11.06	6.67	6.50	8.23
GA	0.13	0.13	0.14	8.30	12.18	9.31	6.28	9.18	6.48
GRE	0.34	0.07	0.05	7.20	5.73	3.21	4.73	3.13	1.84
SAL	0.42	0.38	0.23	13.31	14.27	8.38	9.03	9.08	5.74
PHO	0.29	0.43	0.15	13.31	15.67	3.91	9.79	10.99	6.72
ES	0.28	0.27	0.27	12.06	13.44	12.21	7.16	7.44	6.07
PRU	0.22	0.18	0.20	10.27	11.20	14.65	5.33	5.96	6.29
L&G	0.41	0.34	0.43	24.21	12.34	22.75	18.66	5.71	15.18
NIG	0.55	0.36	0.35	11.93	12.17	11.63	5.71	4.56	4.74
NEM	0.35	0.20	0.22	8.72	3.73	5.54	6.30	1.79	3.08
MUN	0.32	0.15	0.19	4.11	0.29	2.18	3.33	0.29	0.83
FED	0.39	0.24	0.32	7.58	13.97	7.12	3.16	7.37	4.88
CLOV	0.17	0.30	0.20	2.99	15.80	17.24	0.66	9.45	8.29
AVON	0.24	0.33	0.22	11.22	22.16	5.74	8.99	9.61	3.47
BS&B	0.50	0.42	0.28	3.08	2.17	0.70	0.0	1.22	0.0
US	0.36	0.24	0.34	6.09	6.93	7.57	5.41	6.88	5.87
HAL	0.26	0.15	0.14	6.19	11.81	11.34	3.21	10.70	6.54
ANS	0.29	0.35	0.16	9.47	8.17	0.00	1.32	6.13	0.00
NORM	0.56	0.55	0.54	21.90	29.83	12.48	6.05	17.97	7.93

Figures in £000

Basic Chain Ladder  
Estimate of O/S Claims  
Based on date Based on date  
from 1971 from 1972

V. 11

(a)	Company's estimate		=£ 7,993,000
(b)	BCL based on data from 1971 ignoring 'pole factor'		=£10,043,000
(c)	" " " " 1971 with	" "	=£17,287,000
(d)	" " " " 1972 ignoring	" "	=£ 8,264,000
(e)	" " " " 1972 with	" "	=£ 9,645,000

## BIBLIOGRAPHY

Many papers have been written on the analysis of data either in the DOT returns or in equivalent statutory returns overseas. The following is a selection of some of the recently published and readily available papers.

The abbreviations used below are:

GIB	General Insurance Bulletin
IAAS	Institute of Actuaries of Australia, General Insurance Seminar
JIA	Journal of the Institute of Actuaries
PCAS	Proceedings of the Casualty Actuarial Society
TIAA	Transactions of the Institute of Actuaries of Australia
TIAANZ	Transactions of the Institute of Actuaries of Australia and New Zealand

ABBOTT W M et al	Some thoughts on Technical Reserves and Statutory Returns in General Business JIA 101
ARMITAGE A	Statistical Reserving Methods - How Accurate are they? GIRO Bulletin No 23
BEARD R E	Some Historical, Theoretical and Practical Aspects. IMA Symposium on Claims Provisions 1974
BEARD R E	Verification of Outstanding Claims Provisions - Separation Technique Astin Bulletin 9 Part 1
BROWN A	Control of the Tail of Outstanding Claims in Taylor's Separation Method GIB 15
BROWN A	Stability of Claim Payments Patterns IAAS Thredbo 1978
CUMPSTON J R	Adjusted Claims Estimates GIB No 25
CUMPSTON J R and TAYLOR G C	Tests on the Adequacy of Provisions for Employers Liability Outstanding Claims GIB No 9
HOMEWOOD C J	An Administrator's Definition of the Problem IMA Symposium on Claims Provisions 1974
HOOSON R	Some Aspects of Triangulation Methods in Claims Reserving. GIRO Bulletin No 14
JUDGE R A	Claims Provisions - The Commissioners View IAAS Thredbo 1978
KARSTEN H	Estimation of Outstanding Claims from Run Off Data GIRO Seminar 1978
LOCKETT J E and MELLOR C J	Technical Reserves - Liability Sub-report GIRO Seminar 1977
MATTHEWS T J	The Valuation of General Insurance Claims Reserves IAAS Thredbo 1978
RYDER J M	Claims Estimation Models IAAS Thredbo 1978

SAWKINS R W	Analysis of Claims Run-Off Data - A Broad View IAAS Thredbo 1978
SAWKINS R W	Some Problems of Long Term Claims in General Insurance TIAANZ 1975
TAYLOR G C	Claim Size Distribution and Outstanding Claims Provisions GIB No 27
TAYLOR G C	Separation of Inflation and Other Effects from the Distribution of Non-Life Insurance Claim Delays Astin Bulletin 9 Part 1
TAYLOR G C	Testing Goodness-of-fit of an Estimated Run-Off Triangle. Astin Bulletin 10 Part 1
TAYLOR G C and MATTHEWS T J	Experimentation with the Estimation of the Provision for Outstanding Claims in Non-Life Insurance TIAA 1977
TRUCKLE W W	Estimating Claims Reserves in General Insurance GIRO Bulletin No 20

## HISTORIC RUN-OFF OF INITIAL OUTSTANDING LIABILITY

### 1.0 Introduction

- 1.1 This paper is concerned with tracing the progress of outstanding claims reserves, set up at the end of each year of origin, through subsequent years.
- 1.2 The aim is to see if there is any pattern in this progression between risk groups and between companies.

### 2.0 Source of Data

- 2.1 Schedule 3 Part III of the DoT returns via the N.U. database containing details of the returns of 11 major companies.

### 3.0 Scope of Inquiry

- 3.1 The initial outstanding liability for years 1970-1976 inclusive has been traced through to the end of 1977 for the following risk groups:

- Private Car
  - Employers Liability
  - Personal Accident
  - Fire

### 4.0 Output

- 4.1 A copy of the basic output used is given in Appendix 1. This gives the initial outstanding liability and its value as re-assessed at the end of each year of development. This is also expressed as an index, taking the initial outstanding as 100.
- 4.2 Appendices 2 to 5 give the results of the analysis of the above data and form the basis of any commentary.

### 5.0 Appendix 2

- 5.1 This gives the mean of the indices of all 11 companies for successive years of development, years of origin 1970 to 1976, for each risk group.
- 5.2
  - i) Fire - On average this is adequately reserved in all years with savings emerging as settlement develops.
  - ii) Employers Liability - This appears to have generally been under-valued except, initially, for more recent years of origin. About the 3rd year of development seems to be the peak of this under-valuation.

Continued ...

- iii) Private Cars - Again, a general movement from under-valuation in earlier years of origin to over-valuation in the later years.
- iv) Personal Accident - Generally under-valued with no real pattern. However, many of the accounts in the data are very small.

#### 6.0 Appendix 3

- 6.1 As above, but giving the standard deviations of the indices about the calculated means.
- 6.2 Variation between companies in the accuracy of their estimates is lowest in Fire business and largest in Personal Accident and Employers Liability. The variation in Private Cars appears to have decreased for later years of origin.

#### 7.0 Appendix 4

- 7.1 As Appendix 2 with indices calculated on a weighted mean basis.
- 7.2 For Fire there appears to be little difference between these and the straight average. The weighting by size of reserves brings down the values for the other accounts particularly Personal Accident. This seems to imply that companies with larger reserves have not been as under-valued as much as the smaller accounts.

#### 8.0 Appendix 5

- 8.1 Co-efficients of correlation between company indices and the all companies indices as given in Appendix 2, for each year of origin and risk group.
- 8.2 1974 and later years of origin were omitted due to the small number of years of development.
- 8.3 The movement in the initial liability for Fire business for individual companies is highly correlated with the movement in the all company liability.
- 8.4 No similar pattern is discernible for the other risk groups.

#### 9.0 Summary

- 9.1 This analysis is an attempt to provide some framework for assessing the success (or otherwise) of company estimates of

Continued ...



outstanding reserves for different risk groups.

- 9.2 Success seems to be varied not only between companies but between risk groups. Size of account and the effect of inflation look to be important areas in any discussion on the adequacy of reserves.

P. A. G. Green  
8th June 1979





RUN-OFF OF INITIAL O/S LIABILITY UN AS AT 1977

Y	O/S LIABILITY		O/S LIABILITY		REVISED LIABILITY AT END OF DEVELOPMENT YEAR:-											
	AT END OF LAST DEVELOPMENT YEAR	AT END OF YEAR OF REPORT	AT END OF LAST DEVELOPMENT YEAR	AT END OF YEAR OF REPORT	1		2		3		4		5		6	
	£'000	£'000	EMPL. LIABILITY	EMPL. LIABILITY	£'000	X	£'000	X	£'000	X	£'000	X	£'000	X	£'000	X
A																
1970	51.3	350.1			392.2	112	435.0	125	538.8	154	582.8	166	576.3	165	575.2	164
1971	17.0	327.1			367.3	113	493.9	151	604.8	185	586.9	179	577.8	177	551.3	169
1972	147.5	478.1			761.3	159	1001.0	209	1029.8	215	1017.0	213	1014.0	212		
1973	331.3	1065.1			1604.3	151	1627.4	153	1664.0	156	1655.9	155				
1974	841.2	1464.7			1727.2	110	1709.0	117	1883.8	129						
1975	870.3	1759.5			1434.5	82	1406.3	80								
1976	1225.0	1357.1			1489.1	110										
1977	2761.6	2761.6														
B																
1970	332.2	7284.1			7145.7	98	7359.5	101	7521.9	103	7657.9	105	7962.9	109	7838.6	108
1971	896.1	7031.8			7513.7	98	8316.0	109	8692.5	114	8711.4	114	9281.6	122	9230.4	121
1972	1473.2	9275.1			9698.4	105	9635.4	104	9754.6	105	10198.8	110	10235.2	110		
1973	3431.1	12171.0			12023.5	99	12951.0	106	13552.4	111	13537.9	111				
1974	6157.7	14594.8			14965.5	103	15074.5	103	15217.7	104						
1975	10037.6	17079.0			16772.8	98	16848.4	99								
1976	19789.4	23582.7			23977.3	102										
1977	30656.5	30656.5														
C																
1970	70.0	230.0			208.0	90	229.0	100	228.0	99	251.0	109	231.0	100	235.0	102
1971	14.0	327.0			293.0	90	298.0	91	316.0	97	315.0	96	325.0	99	324.0	99
1972	46.0	377.0			315.0	83	365.0	97	393.0	104	368.0	98	375.0	99		
1973	71.0	491.0			455.0	93	448.0	91	443.0	90	417.0	85				
1974	345.0	522.0			502.0	96	580.0	111	716.0	137						
1975	320.0	662.0			536.0	81	578.0	87								
1976	779.0	826.0			891.0	108										
1977	852.0	852.0														
D																
1970	7.5	350.5			423.3	121	472.1	135	450.0	128	432.1	123	456.1	130	424.4	121
1971	8.8	288.3			384.1	133	452.3	157	434.9	151	372.0	129	360.2	125	323.6	112
1972	101.2	400.6			487.0	122	453.8	113	430.6	107	404.2	101	424.2	106		
1973	86.7	513.9			449.5	109	450.0	101	405.7	98	431.6	104				
1974	363.2	565.2			555.2	95	618.3	109	642.1	114						
1975	449.0	667.4			667.4	85	635.2	95								
1976	676.1	816.1			788.8	97										
1977	935.3	935.3														
E																
1970	5.0	124.0			159.0	128	158.0	127	152.0	123	155.0	125	162.0	131	163.0	131
1971	35.0	151.0			226.0	150	249.0	165	266.0	176	295.0	195	260.0	172	242.0	160
1972	94.0	279.0			300.0	129	481.0	172	607.0	218	565.0	203	586.0	210		
1973	273.0	645.0			626.0	97	863.0	134	803.0	124	845.0	131				
1974	673.0	1434.0			1284.0	90	1224.0	85	1298.0	91						
1975	680.0	988.0			934.0	95	1011.0	102								
1976	1035.0	1241.0			1156.0	93										
1977	1406.0	1406.0														

APPENDIX 1

RUN-OFF OF INITIAL O/S LIABILITY UK AS AT 1977

O/S LIABILITY AT END OF DEVELOPMENT YEAR			REVISED LIABILITY AT END OF DEVELOPMENT YEAR:-											
YEAR	1		2		3		4		5		6			
	£'000	£'000	£'000	£'000	£'000	£'000	£'000	£'000	£'000	£'000	£'000			
F														
EMPL. LIABILITY														
1970	43.6	774.8	873.5	113	831.7	107	889.4	115	878.9	113	880.7	114	867.1	112
1971	139.9	756.5	815.4	108	917.4	121	944.2	125	906.3	120	921.0	122	1002.6	133
1972	53.8	1004.4	1059.1	109	1300.9	110	1350.0	134	1321.5	132	1228.6	122		
1973	249.8	1714.9	1714.9	118	1811.4	125	1718.1	119	1586.5	109				
1974	663.0	1787.0	1478.6	94	1673.7	94	1716.0	97						
1975	1195.0	2230.0	1797.9	81	1936.7	87								
1976	1338.9	1723.9	1617.1	94										
1977	2313.6	2313.6												
G														
EMPL. LIABILITY														
1970	73.0	2441.4	2679.4	110	3083.3	159	3602.7	148	3494.7	143	3469.8	142	3453.7	141
1971	208.9	3216.1	2719.3	167	4460.6	115	4545.2	142	4552.3	142	4517.4	140	4449.1	138
1972	769.9	7077.6	6133.0	87	5801.9	82	5712.1	81	5599.4	79	5695.7	80		
1973	1591.4	9159.0	7810.3	81	7543.8	81	7618.3	82	7320.1	78				
1974	3511.8	8622.1	7891.1	92	8396.0	97	8440.3	98						
1975	6432.9	9164.8	9873.0	107	9880.2	108								
1976	9499.1	12516.2	11314.0	90										
1977	9860.0	9860.0												
H														
EMPL. LIABILITY														
1970	216.8	1504.9	1731.2	115	2010.3	114	1971.5	131	1797.5	119	1795.3	119	1851.3	123
1971	108.2	1915.5	1915.2	101	1937.4	101	1767.1	92	1630.8	85	1560.3	81	1564.7	82
1972	236.4	2457.4	2260.6	92	2076.7	85	2015.1	83	1755.7	71	1690.8	69		
1973	635.7	3563.8	3026.8	85	2953.4	83	2707.5	76	1440.4	68				
1974	1275.8	3231.5	3394.0	105	2921.6	90	2846.4	88						
1975	2310.1	4628.2	3878.1	84	3540.7	77								
1976	3312.4	4922.4	3864.4	79										
1977	5008.7	5008.7												
I														
EMPL. LIABILITY														
1970	141.4	1181.0	1091.0	92	1076.0	91	1048.0	89	989.0	84	1105.2	96	1124.0	95
1971	178.3	1308.0	1270.0	97	1216.0	93	1228.0	94	1300.0	99	1297.7	99	1244.2	95
1972	370.5	1597.0	1540.0	97	1668.0	105	1715.8	109	1643.8	103	1633.4	103		
1973	443.2	2144.0	2208.0	103	2306.0	108	2033.9	96	1841.1	86				
1974	1144.4	1844.0	2299.7	115	2905.8	115	2592.8	102						
1975	3301.9	4195.1	4760.0	113	4623.6	110								
1976	4130.4	4930.6	4764.5	97										
1977	6326.1	6326.1												
J														
EMPL. LIABILITY														
1970	7.6	960.0	1130.0	120	1542.7	161	1710.4	178	1553.5	162	1496.8	156	1480.8	154
1971	63.8	1260.0	1423.0	113	1265.8	156	1584.9	126	1608.1	128	1554.6	123	1569.2	125
1972	186.9	2135.4	2433.1	115	2011.6	94	1958.4	92	1956.1	92	1981.8	93		
1973	283.8	2105.3	2697.5	117	2392.7	104	2452.2	106	2433.7	106				
1974	865.7	3673.0	3026.2	82	3239.3	88	3315.9	90						
1975	2272.6	4401.0	4181.0	95	4650.1	106								
1976	4949.7	6778.8	6334.4	93										
1977	9516.8	9516.8												
K														
EMPL. LIABILITY														
1970	98.9	958.0	1341.3	140	1539.9	161	1698.9	177	1782.2	186	1779.4	186	1735.0	181
1971	121.7	1138.8	1174.7	103	1279.2	112	1405.1	123	1278.0	112	1227.0	108	1216.1	107
1972	181.7	1944.7	1285.3	123	1575.0	131	1581.2	151	1489.3	143	1438.9	138		
1973	535.8	1368.6	1800.7	132	2054.5	150	2186.1	160	2111.1	154				
1974	990.0	1862.9	2211.1	119	2254.8	121	2218.3	120						
1975	1395.4	2091.5	2167.9	104	2248.5	108								
1976	2388.8	2567.2	2800.1	109										
1977	3617.9	3617.9												

# APPENDIX 1

## RUN-OFF OF INITIAL O/S LIABILITY UK AS AT 1977

	O/S LIABILITY AT END OF LAST DEVELOPMENT YEAR	REVISED LIABILITY AT END OF DEVELOPMENT YEAR:-					
		1	2	3	4	5	6
	£'000	£'000	£'000	£'000	£'000	£'000	£'000
<b>A</b>							
PERSONAL ACCID.							
1970	0.2	76.0	90.6	166	92.5	169	92.2
1971	0.5	114.8	117.2	123	112.9	118	113.7
1972	1.6	105.7	113.5	107	120.2	114	118.8
1973	5.1	130.2	151.9	117	158.8	122	161.2
1974	15.9	175.2	206.0	118	217.8	118	217.8
1975	145.0	167.4	307.8	184			
1976	50.0	206.5	181.6	88			
1977	650.6						
<b>B</b>							
PERSONAL ACCID.							
1970	5.6	247.0	287.4	116	291.0	118	290.2
1971	0.3	214.9	263.4	123	272.8	127	251.8
1972	4.1	299.6	407.2	136	407.8	136	410.7
1973	107.9	398.7	442.4	111	464.9	117	462.7
1974	11.0	337.2	476.6	141	451.1	132	
1975	51.2	524.5	466.6	89	453.2		
1976	76.0	471.1	317.8	67			
1977	927.9						
<b>C</b>							
PERSONAL ACCID.							
1970	201.0	185.0	188.0	94	187.0	93	188.0
1971	225.0	186.0	186.0	84	184.0	83	186.0
1972	227.0	201.0	201.0	90	201.0	89	201.0
1973	264.0	251.0	255.0	97	250.0	95	249.9
1974	291.0	287.0	288.0	99	287.0	99	
1975	341.0	346.0	338.0	101	338.0	99	
1976	364.0	368.0		96			
1977	394.0						
<b>D</b>							
PERSONAL ACCID.							
1970	106.6	101.8	98.7	93	98.0	92	95.5
1971	88.0	92.3	88.3	100	88.3	100	88.7
1972	92.9	93.4	86.7	93	87.0	94	87.1
1973	95.8	92.5	84.0	88	86.3	90	86.3
1974	114.9	133.8	124.2	108	121.8	106	
1975	108.6	113.6	104.0	96			
1976	153.6	135.9		89			
1977	147.2						
<b>E</b>							
PERSONAL ACCID.							
1970	16.0	26.0	26.0	163	25.0	156	25.0
1971	16.0	29.0	31.0	194	30.0	188	30.0
1972	32.0	30.0	31.0	97	29.0	91	32.0
1973	31.0	44.0	47.0	152	44.0	142	44.0
1974	59.0	71.0	75.0	127	73.0	124	
1975	98.0	207.0	211	218.0			
1976	308.0	602.0		195			
1977	909.0						

RUH-OFF OF INITIAL D/S LIABILITY UK AS AT 1977

[illegible]

## APPENDIX I

## RUN-OFF OF INITIAL O/S LIABILITY UK AS AT 1977

O/S LIABILITY AT END OF LAST DEVELOPMENT YEAR	£'000	REVISED LIABILITY AT END OF DEVELOPMENT YEARS:-						A
		1	2	3	4	5	6	
YEAR	£'000	£'000	£'000	£'000	£'000	£'000	£'000	£'000
<b>F</b>								
FIRE								
1970	6.3	2259.7	63 1993.9	73 1981.7	73 1878.3	69 1977.6	69 1941.5	68
1971	34.1	2387.5	74 2295.9	71 2150.5	67 2081.3	65 2008.5	62 1987.3	62
1972	24.4	3576.0	79 3156.8	69 2890.8	64 2720.5	60 2522.2	56	
1973	112.9	5537.2	85 5262.9	81 5102.5	78 5046.3	78		
1974	932.2	8297.8	89 7021.3	85 7100.9	86			
1975	517.7	6316.1	83 5107.8	80				
1976	2272.7	8697.3	76					
1977	10890.3							
<b>G</b>								
FIRE								
1970	4.6	6043.0	84 4940.8	82 4637.9	77 4546.7	75 4527.0	75 4518.8	75
1971	-6.3	5367.3	91 4032.4	75 3779.0	70 3507.6	65 3555.3	66 3502.1	65
1972	54.2	6816.4	88 5296.6	78 5033.0	74 4941.5	72 4652.1	68	
1973	204.7	12296.6	78 8734.2	71 8503.3	69 8259.8	67		
1974	193.3	14697.9	82 11358.2	78 10378.2	72			
1975	1732.2	13608.7	85 10935.8	80				
1976	9445.5	15682.4	138					
1977	22444.6							
<b>H</b>								
FIRE								
1970	84.4	5317.8	80 4004.8	75 3821.1	72 3739.3	70 3750.8	71 3759.2	71
1971	194.3	4961.3	84 3956.1	80 3740.1	75 3706.2	75 3705.8	75 3663.9	74
1972	329.7	6874.2	85 3369.1	78 3171.5	75 3076.6	74 3020.8	73	
1973	575.6	10645.6	90 8926.4	84 8671.8	81 8461.6	79		
1974	1806.0	12448.2	89 10368.6	83 10430.6	84			
1975	1222.0	13593.1	79 10089.5	74				
1976	4798.7	13627.6	86					
1977	19121.6	19121.6						
<b>I</b>								
FIRE								
1970	4.1	3405.0	75 2394.0	70 2333.0	69 2234.0	64 2229.9	65 2252.3	66
1971	42.2	3397.0	88 2891.0	85 2741.0	81 2699.7	79 2618.9	77 2614.2	77
1972	59.1	4983.0	82 3814.0	77 3410.2	73 3375.1	72 3314.5	71	
1973	166.0	7074.0	77 3127.5	72 2936.4	70 2862.9	69		
1974	431.2	11090.0	83 8708.2	79 8533.5	77			
1975	1183.4	10643.6	8687.2	81 7940.2	75			
1976	3185.3	12665.9	79					
1977	15071.0	15071.0						
<b>J</b>								
FIRE								
1970	30.7	5705.0	78 4253.2	75 4172.2	73 4047.2	71 4037.5	71 4003.0	70
1971	116.4	6799.0	70 4364.9	65 4165.1	61 3909.2	57 3738.7	55 3698.7	54
1972	193.9	7038.2	79 5081.3	72 4612.3	64 4191.3	60 3990.3	57	
1973	147.2	9743.0	79 6959.9	71 6598.5	67 6416.9	66		
1974	458.2	11680.4	79 8285.9	72 7888.9	69			
1975	1097.6	11294.6	76 8004.6	71				
1976	5880.0	17099.7	82					
1977	20877.2	20877.2						
<b>K</b>								
FIRE								
1970	24.7	5840.7	87 4419.7	83 4653.7	80 4610.2	79 4561.7	78 4545.8	78
1971	44.2	6640.2	83 5129.6	77 4994.5	75 4805.4	72 4762.0	72 4782.0	72
1972	143.9	7556.6	85 6154.7	81 5888.3	78 5719.9	76 5575.4	74	
1973	300.5	12136.0	89 10143.8	84 9871.7	81 9653.9	80		
1974	576.9	15603.0	93 13854.7	89 13594.2	87			
1975	2282.4	14948.6	13758.2	92 12964.5	87			
1976	14409.3	50780.3	29021.9	94				
1977	24115.1	24115.1						



MEAN OF COMPANY INDICESFIRE

<u>Year of Origin</u>	<u>End of Year of Development</u>					
	1	2	3	4	5	6
1970	82.9	77.0	74.9	72.9	72.5	72.1
1971	82.5	77.0	73.4	70.6	69.9	69.5
1972	86.6	79.9	75.1	72.1	69.9	
1973	87.5	82.5	79.5	77.4		
1974	88.7	85.3	82.8			
1975	86.5	81.0				
1976	88.4					

PRIVATE CARS

1970	111.3	118.6	119.9	119.2	119.7	119.0
1971	104.5	105.4	108.5	108.7	108.5	110.0
1972	97.5	101.5	102.5	101.5	101.8	
1973	98.5	98.1	96.4	101.8		
1974	94.9	92.7	92.2			
1975	92.9	90.3				
1976	95.1					

EMPLOYERS LIABILITY

1970	112.6	127.3	131.3	130.4	131.4	130.1
1971	113.9	127.3	129.5	127.1	124.3	121.9
1972	110.0	122.0	127.1	122.2	122.0	
1973	107.7	112.3	110.7	107.9		
1974	101.0	102.7	106.3			
1975	93.1	96.2				
1976	97.4					

PERSONAL ACCIDENT

1970	114.0	117.4	116.2	115.9	115.5	115.5
1971	109.0	109.1	108.6	107.6	107.3	107.4
1972	101.5	100.0	98.2	98.5	98.5	
1973	105.6	106.0	104.5	105.0		
1974	106.2	106.0	105.6			
1975	120.2	110.3				
1976	106.4					

APPENDIX 3

STANDARD DEVIATIONS OF INDICES ABOUT THE  
MEANS GIVEN IN APPENDIX 2

FIRE

<u>Year of</u> <u>Origin</u>	<u>End of Year of Development</u>					
	1	2	3	4	5	6
1970	7.0	5.7	5.6	5.6	5.1	4.8
1971	8.1	8.6	9.2	9.6	9.8	10.2
1972	7.9	9.4	9.8	10.9	12.0	
1973	6.8	8.1	8.2	7.9		
1974	6.6	7.8	8.2			
1975	7.0	6.8				
1976	18.5					

PRIVATE CARS

1970	19.1	24.6	23.7	22.6	24.0	24.5
1971	14.2	16.1	19.2	20.2	21.1	25.5
1972	9.2	13.4	15.4	15.6	16.0	
1973	8.5	11.9	13.4	14.4		
1974	10.0	13.1	15.3			
1975	5.8	9.0				
1976	12.4					

EMPLOYERS LIABILITY

1970	15.1	25.6	30.1	30.5	28.6	27.2
1971	20.5	27.9	31.5	33.9	29.6	26.9
1972	22.1	40.1	48.6	47.2	47.8	
1973	20.8	25.0	27.5	29.0		
1974	12.1	12.6	16.5			
1975	11.4	11.9				
1976	9.3					

PERSONAL ACCIDENT

1970	24.7	28.8	27.8	28.0	28.9	29.3
1971	33.1	33.2	30.8	30.6	30.6	30.6
1972	19.9	19.9	21.5	21.3	21.8	
1973	16.6	22.4	20.7	20.9		
1974	18.5	18.4	18.6			
1975	37.9	44.3				
1976	32.4					

WEIGHTED - MEANS OF COMPANY INDICESFIRE

<u>Year of Origin</u>	<u>End of Year of Development</u>					
	1	2	3	4	5	6
1970	84.3	77.8	75.2	73.4	73.0	72.6
1971	81.6	75.7	72.0	69.3	68.3	67.9
1972	85.7	78.7	73.9	71.2	69.0	
1973	85.5	79.9	77.4	75.4		
1974	87.6	83.6	81.2			
1975	85.5	80.1				
1976	90.9					

PRIVATE CARS

1970	106.7	112.1	113.8	113.2	114.7	113.7
1971	102.0	101.8	102.9	102.2	101.4	101.5
1972	96.3	99.2	100.7	99.4	99.0	
1973	98.2	97.0	94.9	92.9		
1974	93.8	90.8	88.9			
1975	91.6	87.7				
1976	92.9					

EMPLOYERS LIABILITY

1970	106.4	120.9	122.6	121.1	123.2	122.2
1971	109.8	118.9	119.0	117.7	119.5	118.5
1972	101.1	100.9	101.8	100.8	100.7	
1973	97.8	101.1	102.0	99.0		
1974	99.7	100.8	101.6			
1975	97.9	98.9				
1976	97.9					

PERSONAL ACCIDENT

1970	104.8	106.1	105.4	105.1	103.7	115.5
1971	98.3	97.4	98.4	96.8	96.7	107.4
1972	98.7	97.3	93.8	93.3	93.3	
1973	99.8	98.2	97.0	97.1		
1974	100.0	98.6	98.0			
1975	105.6	103.8				
1976	103.8					

APPENDIX 5

CO-EFFICIENTS OF CORRELATION BETWEEN INDIVIDUAL  
COMPANY INDICES TO ALL-COMPANY INDICES

<u>Company</u>	<u>FIRE</u>				<u>PRIVATE CARS</u>			
	<u>Year of Origin</u>				<u>Year of Origin</u>			
	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
A	.966	.940	.982	.864	.952	.966	.716	-.822
B	.985	.957	.996	.999	.599	.692	.976	.119
C	.968	.929	.898	.968	.670	.733	.649	-.320
D	.956	.967	.954	.818	.883	.937	.973	.470
E	.928	.979	.974	.997	.553	.950	.792	-.700
F	.986	.974	.997	.980	.890	.956	.937	-.202
G	.948	.979	.990	.988	.920	-.969	-.907	.935
H	.983	.972	.978	.998	-.387	-.915	-.900	.833
I	.985	.986	.992	.990	.766	-.586	.620	.871
J	.984	.990	.993	.988	.915	-.767	.902	.756
K	.991	.992	.998	.995	.290	.657	.895	.987

<u>Company</u>	<u>EMPLOYERS LIABILITY</u>				<u>PERSONAL ACCIDENT</u>			
	<u>Year of Origin</u>				<u>Year of Origin</u>			
	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
A	.848	.833	.951	.239	.684	.647	-.692	-.617
B	.434	.538	.161	.267	.664	.842	-.825	-.294
C	.793	.401	.995	.243	.658	.494	.864	.732
D	.363	.441	-.788	-.763	-.253	.436	.791	.106
E	-.076	.734	.919	.592	-.035	-.014	-.214	.732
F	.086	.550	.929	.798	.684	-.663	-.622	-.504
G	.827	-.358	-.837	.542	-.086	.984	.971	.259
H	.444	-.255	-.513	.290	-.317	.392	.976	.732
I	-.145	-.260	.962	.558	-.731	-.008	.755	.680
J	.899	.586	-.943	-.675	.964	.820	.890	.788
K	.932	.836	.912	.477	.368	-.344	.908	.406

APPENDIX 6COMPANY CODES ARE AS FOLLOWS:

A	Phoenix
B	Eagle Star
C	Prudential
D	Co-Operative
E	Legal & General
F	Norwich Union
G	Commercial Union
H	Royal
I	General Accident
J	G.R.E.
K	Sun Alliance