Section F
CASE ESTIMATES & THE PROJECTION OF INCURRED CLAIMS

Preamble

At a given reserving date, more is usually known than the bare fact of the actual claim payments. For each class of business, there will be a number of claims still outstanding, and to these claims individual estimates will be attached by the claims office. Hence the reserver will have a further source of information towards producing a final figure for the liability. The question that arises will be as to the adequacy of these case estimates — if they are compounded with the paid amounts on settled claims, how close will the figure be to the ultimate loss on the business?

The quantity obtained by adding the case reserves to the paid claims is commonly called the "incurred claims". It turns out that the set of methods derived for projecting paid claims to the ultimate can be applied in just the same way to the incurred claims. Comparison of the results with the paid claim projections can be instructive. But this time, there are more possible disturbing influences at work — as well as the settlement pattern, the reporting pattern of the claims has to be considered. And as well as the adequacy of the case reserves, their consistency over time is of prime importance. One useful development of the projection techniques enables the reserver to assess this consistency. The example of the previous section is extended here to continue the illustration by numerical means.

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[F1]
NATURE OF CASE ESTIMATES

The Manual is essentially devoted to the statistical aspect of claims reserving — dealing in terms of aggregate figures for the different classes of business. But there is another aspect, which concerns making estimates on the individual claims as they arise. It also is of great importance, but is properly the responsibility of the claims office, and so falls outside the scope of the present work. Clearly it is a wide field, requiring detailed and particular knowledge of the classes of insurance, and of the changing legal, social and economic influences which come to bear on them.

For the reserver using statistical/actuarial methods, this very detailed knowledge will not be a prerequisite, nor indeed practical to achieve in all the many classes of insurance. But though he or she will not be charged with making the individual case estimates, the reserver will often have to use these estimates as an input. Indeed, in certain classes of business, such as commercial fire or liability, it would be difficult or impossible to dispense with the case reserves.

In such classes, the simplest reserving method would be just to take the case estimates in toto as the reserve for reported claims. But one step on from this would be to make a percentage adjustment to the estimates. The adjustment would need to be determined from a study of actual past losses and the case reserves earlier made in relation to them — and hence the statistical work begins. The case reserves are also needed as a component of the incurred claims function, dealt with in §F2–F4.

Claims Office Practice

Case estimates or case reserves, then, serve as an important starting point for statistical work. It follows that the reserver must have a good understanding of the practice of the company's claims office in this respect. For example, what principles are followed in setting the individual estimates, and how are such influences as inflation accounted for? What level of adequacy is expected in the estimates, and how is consistency from year to year achieved? Indeed, is consistency achieved at all? Perhaps there have been significant changes in claims personnel, or in the guidelines issued to the claims inspectors. Such factors, if known to be operating, can change the interpretation to be put on the resulting case figures.

Another point to watch is that estimating practice can differ according to the class of business in question. Thus, it is commonly found that commercial fire figures tend to be overestimates of the eventual loss, but that in liability the reverse is the case.

Why should this be so? The answers to such questions can be revealing. Take the commercial fire class first. Property damage can be relatively straightforward to assess, but there will always be a possibility of a difference of opinion with the insured. If the estimator puts down a figure on the high side of the reasonable range, it is likely that he or she will eventually be able to settle for somewhat less. Thus to gain a *reduction* from the original estimate will show in a better light for the company than if the reserver were to start at a lower figure and suffer an *increase* at the time of settlement. That is not to say that such practices are always followed, or indeed followed deliberately at all, but there is a clear motivating factor at work.

With liability cases, other considerations entirely come in. The problem here is that many claims cannot be properly assessed, even for several years after their notification. This is particularly true with industrial diseases, where the symptoms may take a long time to reach full development. In the early years, there is just not enough information to go on. Further, the influence of economic and social inflation between the reserving and settlement dates can make the original estimates look quite inadequate. It is always a problem with the longer tailed classes of business.

The Treatment of Inflation

The point about inflation leads to a crucial distinction with regard to claims office practice. Two quite different estimating regimes can be followed:

a) To assess the claim for its loss value as if it were to be settled immediately

b) To assess it for loss as at the likely future date of settlement.

Of these, the first is by far the simpler. The estimator has only to assess the severity of the claim according to the most recent information, and in terms of the currency of the day. If the second is followed, then a number of complications are found to enter. In addition to the immediate severity, the estimator must also consider:

- The likely period to settlement.
- The rate of economic inflation in the interim.
- The influence of social & judicial trends.
- The possible effect of new legislation.

The complications are probably enough to make the alternative a) preferable in most cases although in practice alternative b) is often followed. It can well be argued that such influences as future inflation can better be dealt with by statistical methods operating on aggregates for the different classes of business, and should be left out from the individual claim figures. Be that as it may, the important matter for the reserver is to be fully aware of the practice applied in the company. He or she will then be able to put the correct interpretation on the case estimate figures when using them as an input to further statistical work.

Case Estimates & Case Reserves

Before proceeding, a point on terminology needs to be made clear. The terms "Case Estimates" and "Case Reserves" are used fairly interchangeably in practice. At times, however, it is useful to distinguish whether the amounts in question are gross or net of any partial payments on the claims. In the Manual, we shall generally use the following convention:

Case Estimate — for the full estimated loss on any claim still open at the accounting date.
Case Reserve — for the estimated liability remaining on such a claim.

If partial payments are nil, then reserve and estimate are equal. Where any payments have been made, the relationship is:

Case Reserve = Case Estimate - Partial Payments to Date

In the Manual, we shall mainly be interested in the case reserve figure, but the estimate may also be needed at times. Normally, the figures will be encountered as aggregated for a given class or subgroup of business.

Average Cost Reserving Systems

There is more to be said on the subject of case estimates. One point in particular concerns the use of average cost reserving systems to replace the case estimates. These are used for classes of business, mostly personal lines, where the large number of small claims means that the setting of individual reserves would be uneconomic. Such systems are described later on in the Manual, in §K2. For the present, we shall concentrate on the use made of case reserves in statistical work, in particular through their contribution to the incurred claims function.

[F2]
THE INCURRED CLAIMS FUNCTION

The amount of *incurred claims,* as a rule, is defined simply as the addition of the *paid claims* and the *case reserves.* The general formulation is: $iC = pC + kV$, and for the particular case of *accident year a* at development time *d*:

$$iC_a(d) = pC_a(d) + kV_a(d)$$

where the class or subgroup of business is understood.

A point to note immediately about the incurred claims is that it is a hybrid function. But, hybrid or not, it brings together the most that is clearly known to date about how the claims are developing on the business in question. It has an element to cover the settled claims (paid claims), and one for those which are still outstanding (the case reserves). Is it not then, already the best estimate of the ultimate losses to be had, and why should any further work be required? The very name "incurred claims" suggests that the job is already done.

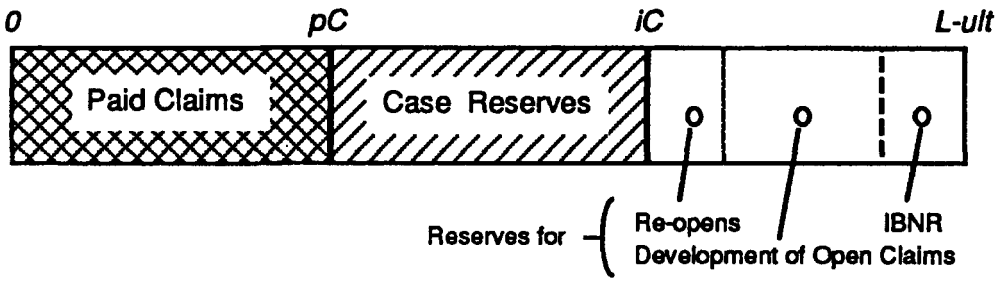
In fact, there are several reasons why the incurred claims (in most cases) cannot be accepted per se as the estimate of ultimate loss. These relate to the inadequacy of the case reserves to stand directly for the remaining liability, and can be stated as follows:

a) *Settled Claims.* Claims already settled can be reopened and further losses incurred. But the case reserves relate only to the outstanding claims, and so contain no allowance for reopens.

b) *Open Claims.* These claims, for which the case reserves have been established, are likely to undergo development between the reserving date and the settlement date. (This development can, of course, be in either direction.)

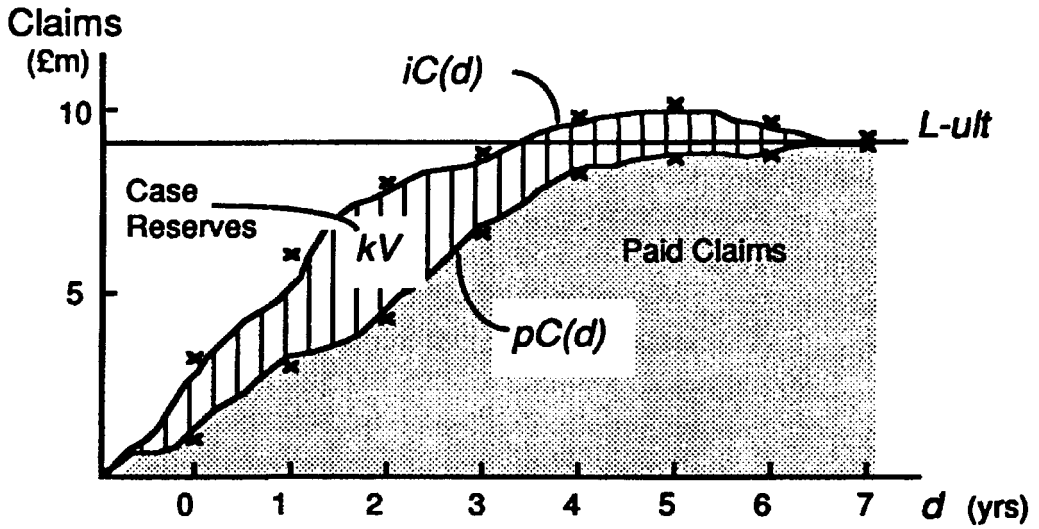
c) *IBNR Claims.* By definition, the IBNR at the reserving date are the claims which have not been reported. They cannot appear in the case estimates, but may still affect the final losses significantly.

To summarise diagrammatically:



It is possible to examine all these features individually, and to build up the ultimate loss by the addition of parts. In particular, the estimate for IBNR is likely to become available, as it will be needed for the statutory returns. But the overall approach will more often be to estimate the final loss directly. This has already been done in §E by projecting the paid claims, and parallel work with the incurred claims function can as easily be done (always provided the data are to hand).

A useful point to note in passing is that both paid claims and incurred claims functions must home in towards the ultimate loss as development time increases for a given accident year. Graphically:



The Incurred Claims Function

Taking the *iC*-function, the graph shows the increasing proportion of the final loss which it covers as time goes by. It is just for one accident year, but if subsequent years can be shown or assumed to follow a similar pattern, then the *iC*-function can be used as a means for making the claim estimates. The principle is the same as it was for the *pC*-function in §E. The only question is of the stability of the pattern as the accident years go by. For paid claims, this came

down to the simple assumption of a stable claim settlement pattern. But incurred claims is a more complex function, and the assumption now becomes a 3-fold one, requiring:

a) A stable settlement pattern (as for *p=C)*
b) A stable claim reporting pattern
c) Consistency in the setting of case reserves.

Thus, curiously, although *iC* has appearance of being an improvement on *pC* (because it is a more complete estimate of the ultimate loss), there is more that can go awry with it. It is wiser to regard it as being neither better nor worse. Most important is the fact that *iC* can give a *new perspective* on the estimating of the ultimate loss and the required reserves.

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[F3]
INCURRED CLAIMS — GROSSING UP

In this section and the next one, we shall illustrate the projection of the incurred claims by means of a numerical example. Technically, the methods are exactly the same as those used for the paid claims in §E above, and all the variations explored there can equally well be applied. Hence we shall be content to exhibit one grossing up variation and one of the link ratio type. The data will be a straight extension of that previously used for the paid claims projections.

The new information that is needed is simply the triangle of the case reserves:

		d					
		0	1	2	3	4	5
	1	1776	1409	1029	606	384	234
	2	2139	1701	1199	809	475	
a	3	2460	1971	1546	969		
	4	3031	2549	1796			
	5	3644	2881				
	6	3929					

As for the paid claims, the figures are in £1,000s, and are given at each development interval for the succeeding accident years. The cumulative paid claim figures will also be needed, and these are repeated again for convenience:

		d					
		0	1	2	3	4	5
	1	1001	1855	2423	2988	3335	3483
	2	1113	2103	2774	3422	3844	
a	3	1265	2433	3233	3977		
	4	1490	2873	3880			
	5	1725	3261				
	6	1889					

To produce the incurred claims figures, we simply add together the paid claims and case reserve triangles, element by element. This gives:

		d					
		0	1	2	3	4	5
	1	2777	3264	3452	3594	3719	3717
	2	3252	3804	3973	4231	4319	
a	3	3725	4404	4779	4946		
	4	4521	5422	5676			
	5	5369	6142				
	6	5818					

As with the paid claims work, the first question that arises is as to the completeness of the development at the point d=5. Even for accident year 1, claims are still outstanding, so that some development *does* remain. However, the case reserves are a small proportion only (about 6.3%) of the incurred claims, and by this stage it may be right to assume that no IBNR reserve is needed. If so, then the incurred claims at d=5 may already provide the best estimate of *L-ult*. The point needs to be confirmed, and an examination of earlier years' data, if available, will help. We will take it, however, that no adjustment to the *iC* figure at d=5 is needed in order to produce the final loss.

The triangle of incurred claims can now immediately be evaluated using the Arabic variation of the grossing up method. We will use a straightforward averaging of the factors in each column, to give a best estimate of the liability. (Remember that the method is to work from right to left down the leading diagonal. For full details of the procedure, refer to §E3.)

	d						
	0	1	2	3	4	5	*ult*
1	2777	3264	3452	3594	3719	3717	3717
	74.7	87.8	92.9	96.7	100.1	100.0%	
2	3252	3804	3973	4231	4319		4315
	75.4	88.2	92.1	98.1	100.1%		
3	3725	4404	4779	4946			5078
	73.4	86.7	94.1	97.4%			
4	4521	5422	5676				6103
	74.1	88.8	93.0%				
5	5369	6142					6987
	76.8	87.9%					
6	5818						7768
	74.9%						
							33,968

Overall Values:	$\sum L\text{-}Ult$	33,968
	$\sum pC^*$	20,334
	Reserve	13,634

The figure for the reserve is appreciably higher than the likely range established under the *pC*-projections. (We had best estimates c. £12,500 and conservative figures at about £13,000.) Further consideration will be given to this discrepancy in §F6.

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[F4]
INCURRED CLAIMS — LINK RATIO METHOD

We now repeat the projection of the incurred claims data, this time using link ratios and making a cautious estimate by taking the *highest* of the ratios shown in each column. The display summarises the working (refer to §E5 for full details. Note the explanation below of a slight variation):

		d						
		0	1	2	3	4	5	*ult*
		1.175	1.058	1.041	1.035	.999	1.000	
	1	2777	3264	3452	3594	3719	3717	3717
		1.170	1.044	1.065	1.021			
	2	3252	3804	3973	4231	4319		4315
						.999		
		1.182	1.085	1.035				
a	3	3725	4404	4779	4946			5114
					1.034			
		1.199	1.047					
	4	4521	5422	5676				6249
				1.101				
		1.144						
	5	5369	6142					7340
			1.195					
	6	5818						8337
		1.433						
								35,072
r		1.199	1.085	1.065	1.035	.999	1.000	
f		1.433	1.195	1.101	1.034	.999	1.000	

Overall Values:	$\sum L\text{-}Ult$	35,072
	$\sum pC^*$	20,334
	Reserve	14,738

(A slight variation has been introduced into the above array, in order to shorten the working a little. The values for *r* and *f* in the two lines under the main triangle

have been found in the usual way. Then the values for *f* have been *written back* against the *iC*-figures in the main diagonal — these are the figures shown in italic. Multiplication immediately yields the loss estimates in the final column, which are summed for the overall loss. Finally, the total of paid claims to date is deducted to give the required reserve.)

The estimate for the reserve here obtained is a good deal higher than any found before. If we are to go by the incurred claims projections as opposed to the paid claims ones, we have both higher estimates and a wider range between the best and the conservative figures. A summary of the position is:

	Best Estimate	Conservative
pC-Projection	12,461	12,931
iC-Projection	13,634	14,738

In both cases, the best estimate is via the Arabic variation of grossing up with averaging of the factors. The conservative estimate is by link ratio method, taking the highest ratio in each column.

The difference between the two sets of figures is marked. Doubt is immediately thrown on the original range of £12,500–13,000 given by the paid claims methods. Perhaps the reserve should now be set rather higher, if the incurred claims projection is to be believed. What is really needed, though, is further investigation of the data, to find whether any systematic cause underlies the difference in the figures, and to say which set is the more reliable. To make the reconciliation is important, because if a similar answer can be found by two different routes, then the credibility of the result is much improved.

However, before engaging on this task, a new projection method is needed, which is introduced in the next sections (§§F5, F6). Then §F7 goes on to tackle the reconciliation proper.

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[F5]
GROSSING UP OF CASE RESERVES

By now, we have estimated the ultimate losses by projections of both the paid and incurred claims figures. But there is a third angle on the work, which brings case reserves themselves to the focus of attention. The idea is to compare the case reserves at each point of development with the true reserves actually needed at that time. If the development of an accident year to maturity follows a stable pattern, then the stability should be reflected in this relationship. It will become possible to project outstanding claims for the later accident years merely by applying a grossing up factor to the latest figure for case reserves.

The main conditions that need to hold are in the stability of the claim settlement and reporting patterns, and in the consistency of the case reserving standards. These are, in fact, no different from the assumptions required for the projection of the incurred claims function itself.

An immediate problem with the method is that *true* reserves are not in general known for the more recent accident years. They can only be found with certainty for those past years which have already reached full development. For such years we have:

$$V_a(d) = L_a\text{-}Ult - pC_a(d)$$

i.e. the true reserve is the ultimate loss less the claims paid to date at each stage. For the later years, some means of hypothecating the reserves must be found. It turns out that this can be done quite easily. Thus, given an initial estimate for the ultimate loss of the accident year, we can write:

$$hV_a(d) = \hat{}L_a\text{-}ult - pC_a(d)$$

letting d run through the various development stages. *(hV is* used as the symbol to stand for *hypothecated* reserve.)

As usual, the whole procedure is best illustrated by working a numerical example. Taking accident year 1 from the main example, the following information is known:

d	0	1	2	3	4	5
pC	1001	1855	2423	2988	3335	3483
kV	1776	1409	1029	606	384	234

The development is not complete, but as seen before (§F3) the case reserves at $d = 5$ may give a reasonable estimate of the outstanding claims. As with the incurred claims projection, we shall assume this to be so. Consequently, the ultimate losses are estimated at: (3483 + 234) = 3717, and from this figure the hypothecated reserves can be found by subtraction:

^L-ult	3717	3717	3717	3717	3717	3717
pC	1001	1855	2423	2988	3335	3483
hV	2716	1862	1294	729	382	234

The next step is to set out the proportions which the actual case reserves bear to these hypothecated figures:

kV	1776	1409	1029	606	384	234
hV	2716	1862	1294	729	382	234
%	65.4	75.7	79.5	83.1	100.5	100.0

which completes the work for accident year 1. For Year 2, the data are:

d	0	1	2	3	4
pC	1113	2103	2774	3422	3844
kV	2139	1701	1199	809	475

To begin work on these figures, we note that the reserve ratio *kV/hV* for Year 1 at $d = 4$ was 100.5%. The assumption of a stable pattern now allows us to apply this same factor to gross up the case reserves for Year 2 at $d = 4$. The result is:

$$475 / 1.005 = 473$$

(Since the factor is greater than 1, the process in this case actually results in a slight *reduction* to the reserves.) Now the estimated final losses for Year 2 must be:

$$3844 + 473 = 4317$$

i.e. adding the known paid claims at $d = 4$ to the grossed up case reserves. The full set of hypothecated reserves for Year 2 can now be derived, and again the case reserve proportions worked out:

d	0	1	2	3	4
^L-ult	4317	4317	4317	4317	4317
pC	1113	2103	2774	3422	3844
hV	3204	2214	1543	895	473
kV	2139	1701	1199	809	475
hV	3204	2214	1543	895	473
%	66.8	76.8	77.7	90.4	100.5

Moving on to Year 3, the data are:

d	0	1	2	3
pC	1265	2433	3233	3977
kV	2460	1971	1546	969

This time, at $d = 3$, we have two values for the reserve ratio *kV/hV*, which are 83.1% from accident year 1, and 90.4% from year 2. The average is 86.8%, which becomes our next grossing factor. Applied to case reserves of 969, it gives a grossed up figure of 1116. Hence the ultimate loss for Year 3 is put at (3977 + 1116) = 5093, and so the process continues.

The procedure should be clear by now, and it will be best to show the whole calculation set out in a double array. The upper part of the array is the familiar triangle of paid claims figures, while the lower part shows the main working.

		d						
		0	1	2	3	4	5	*ult*
	1	1001	1855	2423	2988	3335	3483	
	2	1113	2103	2774	3422	3844		
a	3	1265	2433	3233	3977			
	4	1490	2873	3880			[*pC*]	
	5	1725	3261					
	6	1889						
		65.4	75.7	79.5	83.1	100.5	100.0%	
	1	1776	1409	1029	606	384	234	3717
		2716	1862	1294	729	382	234	
		66.8	76.8	77.7	90.4			
	2	2139	1701	1199	809	475		4317
		3204	2214	1543	895	473		
						100.5%		
		64.3	74.1	83.1				
	3	2460	1971	1546	969			5093
a		3828	2660	1860	1116			
					86.8%			
		65.4	78.5					
	4	3031	2549	1796				6122
		4632	3249	2242				
				80.1%				
		68.6				[%]		
	5	3644	2881			[*kV*]		7037
		5312	3776			[*hV*]		
			76.3%					
	6	3929						7833
		5944						
		66.1%						34,119

The lower array is built up around the triangle of the given case reserves. Its main cells each contain 3 values, of which the central figure is just the case reserve itself. The lower number is then the hypothecated reserve, and the upper number is the proportion which case reserves bear to it. Thus, cell (a=3, d=2) has *kV*'s of 1546, *hV*'s 1860, and proportion $kV/hV = 83.1\%$. The *kV*'s are given, while the other 2 figures are calculated.

The array may best be read by the Arabic technique of working backwards down the main diagonal. In any diagonal cell (except the first), the % figure is found as the average of the %s in the cells above it in its column. Thus, 80.1% in cell (a=4, d=2) is the average of 79.5, 77.7 and 83.1%. This proportion is then applied to gross up the case reserve figure to the hypothecated value, e.g. 1796/ 80.1% = 2242

The next step is to refer to the *pC* triangle above to find the corresponding paid claims — in this case 3880. The addition then gives the estimated final loss for the given accident year:

$$2242 + 3880 = 6122$$

This final loss is written in the extreme right hand column of the lower array, and then the hypothecated reserves are calculated backwards along the row. This again requires reference to the upper triangle of paid claims. Corresponding rows in the two triangles have to be matched, and the reserves found by subtraction. Thus:

$$\begin{array}{ll} \text{at } (a{=}4,\ d{=}1) & 6122 - 2873 = 3249 \\ \text{at } (a{=}4,\ d{=}0) & 6122 - 1490 = 4632 \end{array}$$

The work on the row $a = 4$ is completed by calculating the proportions kV/hV. In this case:

$$\begin{array}{l} 2549/3249 = 78.5\% \\ 3031/4632 = 65.4\% \end{array}$$

Attention now moves to the next lower cell in the main diagonal, and the procedure is repeated until ending as usual in the bottom left hand corner of the array. The final step is to add up the loss estimates in the RH column, and deduct the paid claims to date. The summary of results is:

Overall Values:	$\sum L\text{-}Ult$	34,119
	$\sum pC^*$	20,334
	Reserve	13,785

The final figure for the reserves can be checked against the sum of the hV-figures in the leading diagonal.

Although the method is rather complicated to describe, it is not at all difficult to operate in practice. After a few repetitions the numbers almost find their own places, and the answers fall out with apparent ease. Therein, perhaps, lies the danger. Being taken with the elegance of the algorithm, one may forget to examine critically the results it is giving. With this projection, as much as with the simpler paid and incurred claims projections, it is necessary to shun the idea that the answer is automatically right. The point is pursued in the next section.

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[F6]
ADEQUACY & CONSISTENCY OF CASE RESERVES

When projections are made with incurred claims figures or using case reserves themselves (as in §§F3–F5), one question that should always be asked concerns the adequacy and consistency of the case reserves from year to year. But while the adequacy is certainly something the reserver should be concerned to know about, the really crucial aspect is the consistency. The projections of incurred claims and case reserves do assume this consistency, and if it is not fulfilled then the results can be thrown out of balance.

One useful aspect of the case reserve projection is that it can sometimes throw light on this question. Take the example just given in §F5. The figures for the case reserve grossing factors were almost lost in the welter of detail in the calculation array. It is useful to extract them to stand on their own:

		d					
		0	1	2	3	4	5
	1	65.4	75.7	79.5	83.1	100.5	*100.0%*
	2	66.8	76.8	77.7	90.4	*100.5%*	
a	3	64.3	74.1	83.1	*86.8%*		
	4	65.4	78.5	*80.1%*			
	5	68.6	*76.3%*				
	6	*66.1%*					

Here, the figures in the leading diagonal have been italicised because they have a different status from the other values. In fact, they are just the averages of the figures above them in their respective columns. It is the latter figures, in roman type, which hold the real interest. If each column is scanned, it can be seen that the last of them is noticeably higher than the ones above it in the column. The pattern is repeated all the way up the diagonal from (a=5, d=0) to (a=2, d=3). It is a feature which stands out from the data, and it needs further investigation.

It will be recalled that diagonals of the triangle represent payment years. Hence a noticeable change between adjacent diagonals is a change which can be identified by calendar time. In the present case, there is a distinct change in the kV/hV ratio, occurring at some point in the previous payment year but one — or to put it another way, between the reserving date of 2 years ago, and that of 1 year ago.

What has taken place? The data themselves cannot give the exact cause, though they give a strong pointer. Enquiries should be made of the claims office, and of those responsible for case estimating, to see whether any light can be thrown on the question. This might, for example, reveal the following facts:

> "For some time the office had been aware of under-reserving the open claims in this particular class of business. The underestimation was not thought serious, but then two years ago a new head was appointed to the department with a more punctilious attitude. They instituted changes soon after their appointment to bring the position into better balance, and these were put into effect by the claims staff. As a result, it is believed that case reserves are being set on average 5% higher than before the change."

This information is highly relevant. It means that the incurred claims and case reserve projections previously illustrated are being thrown out of line. But, supposing the 5% change in case reserving level to be correct, the projections can immediately be re-done with adjusted figures. What is needed is to increase the figures in the upper left part of the case reserve triangle by 5%, while leaving those in the two longest diagonals unchanged. This is done below:

		d					
		0	1	2	3	4	5
	1	*1776*	*1409*	*1029*	*606*	384	234
	2	*2139*	*1701*	*1199*	809	475	
a	3	*2460*	*1971*	1546	969		
	4	*3031*	2549	1796			
	5	3644	2881				
	6	3929					

Increase italicised figures by 5%

d ↓

		0	1	2	3	4	5
	1	1865	1479	1080	636	384	234
	2	2246	1786	1259	809	475	
a	3	2583	2070	1546	969		
	4	3183	2549	1796			
	5	3644	2881				
	6	3929					

Having adjusted the case reserves, we will now apply the grossing up procedure of §F5. The full calculation array appears on the next page.

		d						
		0	1	2	3	4	5	*ult*
	1	1001	1855	2423	2988	3335	3483	
	2	1113	2103	2774	3422	3844		
a	3	1265	2433	3233	3977			
	4	1490	2873	3880			[*pC*]	
	5	1725	3261					
	6	1889						
		68.7	79.4	83.5	87.2	100.5	100.0%	
	1	1865	1479	1080	636	384	234	3717
		2716	1862	1294	729	382	234	
		70.1	80.7	81.6	90.4			
	2	2246	1786	1259	809	475		4317
		3204	2214	1543	895	473		
						100.5%		
		67.9	78.6	84.3				
	3	2583	2070	1546	969			5068
a		3803	2635	1835	1091			
					88.8%			
		69.9	80.5					
	4	3183	2549	1796				6041
		4551	3168	2161				
				83.1%				
		70.8				[%]		
	5	3644	3881			[*kV*]		6871
		5146	3610			[*hV*]		
			79.8%					
	6	3929						7542
		5653						
		69.5%						
								33,556

Overall Values:	$\sum$*L-Ult*	33,556
	$\sum$*pC**	20,334
	Reserve	13,222

There has been a pronounced reduction in the final figure for the reserve. It is now £13,222 as compared with £13,785 in §F5, a reduction of 4.1%. It will be interesting to find whether the adjustment in case reserves will similarly affect the incurred claims projection, but that will be tackled in the next section §F7. In the

meantime, it is worth drawing out the triangle of *kV/hV %s* from the above calculation array.

		d					
		0	1	2	3	4	5
	1	68.7	79.4	83.5	87.2	100.5	*100.0%*
	2	70.1	80.7	81.6	90.4	*100.5%*	
a	3	67.9	78.6	84.3	*88.8%*		
	4	69.9	80.5	*83.1%*			
	5	70.8	*79.8%*				
	6	*69.5%*					

Again, the main diagonal of averages is not of note. But, higher in the table, the figures show a very respectable picture. The former irregularity has disappeared, and consistency (at least, so far as it can be judged by this test) is restored to the case reserves. What is more remarkable now, perhaps, is the comparatively slow progress made towards the 100% adequacy goal in development years 2 & 3. It appears that there may be a strong influence here from the IBNR, and from late development in claims already reported.

To sum up, the adjustment to case reserves has been made in the light of good evidence. It has produced a more satisfactory result, both in the analysis of case reserve adequacy (the last triangle above), and in the final figure for the claims reserve. Hence it will be right to prefer the new estimate of £13,222 for the liability over the former one of £13,785.

Final Notes

a) The above working has proceeded by taking *averages* of the % figures in each column, i.e. when deciding on the value to place in the leading diagonal. But it would be possible also to make a cautious estimate by taking the *lowest* of the % figures in each case.

b) Again, it would be possible to use a trending method, or other of the variations given in §E for downward projection of the columns. (But the link ratio technique as such is not appropriate for case reserve projections.)

c) The table of proportions above, showing the relative adequacy of the case reserves at various stages of the claims development, is particularly useful with *report* year data. This is because there is no disturbance from the IBNR claims — the set of claims is, of course, fixed from the beginning. The proportions observed in the table are then a very direct test of the case reserving standards applied by the office.

[F7]
ADJUSTMENT OF INCURRED CLAIMS PROJECTION

The adjustments made in §F6 have naturally had a marked effect on the results of the case reserve projection. But in the incurred claims function, the influence of the case reserves is lessened by the addition of paid claims. One might hypothesise, therefore, that the effect will not be so great. The best course is to make a trial by using the new data. To recap, the adjusted case reserve figures are:

		d					
		0	1	2	3	4	5
	1	1865	1479	1080	636	384	234
	2	2246	1786	1259	809	475	
a	3	2583	2070	1546	969		
	4	3183	2549	1796			
	5	3644	2881				
	6	3929					

To these we add the usual figures for the cumulative paid claims:

		d					
		0	1	2	3	4	5
	1	1001	1855	2423	2988	3335	3483
	2	1113	2103	2774	3422	3844	
a	3	1265	2433	3233	3977		
	4	1490	2873	3880			
	5	1725	3261				
	6	1889					

which gives the adjusted triangle of the incurred claims:

		d					
		0	1	2	3	4	5
	1	2866	3334	3503	3624	3719	3717
	2	3359	3889	4033	4231	4319	
a	3	3848	4503	4779	4946		
	4	4673	5422	5676			
	5	5369	6142				
	6	5818					

We tackle the evaluation as before (§ F3,F4), using grossing up and link ratio methods. The working is shown on the next two pages.

Grossing Up Method

The first trial is by the Arabic version of grossing up, using averaged values of the factors.

		d						
		0	1	2	3	4	5	*ult*
	1	2866	3334	3503	3624	3719	3717	3717
		77.1	89.7	94.2	97.5	100.1	100.0%	
	2	3359	3889	4033	4231	4319		4315
		77.8	90.1	93.5	98.1	100.1%		
	3	3848	4503	4779	4946			5057
a		76.1	89.0	94.5	97.8%			
	4	4673	5422	5676				6032
		77.5	89.9	94.1%				
	5	5369	6142					6847
		78.4	89.7%					
	6	5818						7517
		77.4%						
								33,485

Overall Values:	$\sum L\text{-}Ult$	33,485	
	$\sum pC^*$	20,334	
	Reserve	13,151	(Grossing Up, Best Estimate)

This brings out the required reserve at £13,151, which is a fair reduction from the former value of £13,634. The difference is one of 3.5%, which is almost as much as the reduction in liability of 4.1% given above in the case reserve projections.

Link Ratio Method

The second trial (shown in the table overleaf) is by the link ratio method, with a cautious choice of ratios in each column. (The reduced version of the link ratio display is again used, as in §F4.) The estimate of the required reserve now comes

out at £13,645. Compared with the previous figure of £14,738, this is a reduction of some 7.4%.

		d						
		0	1	2	3	4	5	*ult*
		1.163	1.051	1.035	1.026	.999	1.000	
	1	2866	3334	3503	3624	3719	3717	3717
		1.158	1.037	1.049	1.021			
	2	3252	3804	3973	4231	4319		4315
						.999		
		1.170	1.061	1.035				
a	3	3848	4503	4779	4946			5070
					1.025			
		1.160	1.047					
	4	4673	5422	5676				6102
				1.075				
		1.144						
	5	5369	6142					7008
			1.141					
	6	5818						7767
		1.335						
								33,979
r		1.170	1.061	1.049	1.026	.999	1.000	
f		1.335	1.141	1.075	1.025	.999	1.000	

Overall Values:	$\sum$*L-Ult*	33,979	
	$\sum$*pC**	20,334	
	Reserve	13,645	(Link Ratio, Cautious Estimate)

Having adjusted the case reserves, and reworked the figures for the incurred claims projections, we can return to the question posed at the end of §F4: "Can there be any systematic reason for the divergence of the projected reserves as given by the paid claims and incurred claims methods respectively?" Clearly, we have uncovered one such systematic cause in the inconsistency of the given case reserves. This made for a distortion in the incurred claims projection, which has now been corrected. The full comparison of the paid and incurred claims figures is now:

	Best Estimate	Conservative
pC-Projection	12,461	12,931
iC-Projection	13,634	14,738
iC-Adjusted	13,151	13,645

While the *pC* and *iC* figures are still not coincident, the agreement is a great deal better. Also, the range of values suggested by the *iC* projections has narrowed to a more acceptable figure. Choices will still have to be made, or further investigations carried out. But a partial reconciliation is better than none at all. If no further evidence were forthcoming, one might take averages of the *pC* and *iC*-adjusted figures. Thus:

Best Estimate - 12,806 Conservative - 13,288

Final Note on the Incurred Claims

In projections, the incurred claims function has the habit of looking rather similar in general form to the paid claims. Certainly, it can be treated by just the same statistical techniques described in §E. But in fact it is a *hybrid,* and the reserver should not lose sight of this fact.

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