THE ACTUARY AND IBNR

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Incurred But Not Reported loss reserves (hereinafter referred to as IBNR reserves) represent vast sums of money, exceeding $100,000,000 for a number of U.S. property and liability insurers. Nevertheless, the subject has had little attention in the literature of insurance, especially the *Proceedings of the Casualty Actuarial Society*. Although the situation is changing in recent times, the lack of articles, discussions and other related means of presenting the theory and practice of IBNR reserves leads one to conclude that the subject has suffered from neglect over the years and companies have not been allocating sufficient time and talent to this subject.

In an attempt to generate some actuarial interest in this important subject, the authors will describe some theories concerning IBNR reserves which have evolved over the years of handling one of the largest such reserve structures in the United States. Interestingly enough, the theories discussed in this paper have the added advantage of being adaptable to small or medium size insurers and can also apply to areas where credible statistics are unavailable, areas such as reinsurance, casualty umbrella business, etc.

DEFINITION OF IBNR

IBNR reserves represent an important cog in the insurance accounting machinery, especially where a substantial amount of casualty insurance is written. Obviously, inaccurate IBNR reserves will lead to non-optimal management decisions. It is not only prudent accounting practice to have proper IBNR provisions, but it is required by law. It is, for example, stated in Article 72 of the New York Insurance law that: "every insurer shall maintain reserves in an amount estimated in the aggregate to provide for the payment of all losses or claims incurred on or prior to the date of settlement whether reported or unreported which are unpaid as of such date and for which such insurer may be liable, and also reserves in an amount estimated to provide for the expenses of adjustments or settlement of such claims".

Many companies appear to take the narrow view that an IBNR reserve is intended to provide only for liability which is presently unknown because the claims have not yet been reported. Perhaps the first point that should be emphasized is that there is no rational basis for this practice. The words which stand behind the expression IBNR, *Incurred But Not Reported*, do not require the restricted definition which has been traditionally accorded them. It is our contention that liability which is unknown at present but which will eventuate as a result of adverse developments on reported claims is *Incurred But Not Reported*, just as surely as liability on unreported cases.

It is recognized that the developments on reported cases could be favorable and such developments should be contemplated in the overall IBNR reserve structure. As will be developed later in the text, it is quite practical to provide for both types of liability when developing the IBNR reserve. While there is nothing to be gained by splitting the two types of development as far as the establishment of reserves is concerned, it is recognized that it is desirable to be able to discern the two types of development in a management information system. For example, this separate distinction will allow the use of adverse, or favorable, developments on previously reported cases as a form of "report card" on the Claims Department.

For many property-oriented companies, IBNR reserves mainly serve the purpose of providing for the lag in booking November and December losses. By three months beyond the closing date most loss developments have been booked and a particular IBNR reserve is needed for only a short period of time. Companies are finding that the same is not true for casualty business. There is still a year-end lag; however, there is also a further tail for which substantial IBNR reserves must be carried. For those companies in the casualty excess or reinsurance area, IBNR reserves have become enormous in size.

1934 Tarbell Paper

As mentioned previously, the *Proceedings* are relatively barren of papers on the subject of IBNR reserves; however, a paper written by Mr. Thomas F. Tarbell in 1934 is an excellent treatise on the subject.

If one were to survey today's IBNR computational techniques and then reread Mr. Tarbell's 1934 paper, one might conclude that it must still be 1934. On the one hand this is a great tribute to Mr. Tarbell, who very ably and concisely articulated some basic IBNR concepts. Yet, on the other hand, it is also a serious indictment against the actuarial profession that those particular skills have not been sharpened in almost 40 years.

Mr. Tarbell's basic formula was [1] :

$$\frac{N^{y}\ 10\text{-}11\text{-}12 \times C^{y}\ 10\text{-}11\text{-}12}{N^{y-1}10\text{-}11\text{-}12 \times C^{y-1}\ 10\text{-}11\text{-}12} \times I^{y-1}\ (1)\ldots(12)$$

Where: N = Number of notices
C = Average incurred per notice
I = Amount of IBNR
y = Designates current year
y-1 = Designates previous year
Subscripts denote month

In other words, the actual IBNR (narrow definition) as realized in a given period of time was related to some base, and the resulting factor was then applied to the current base. Any number of things can be used as a base including earned premiums, case incurred, outstanding case reserves, or premiums in force, as long as the selected base is responsive to changes in IBNR exposure. Mr. Tarbell used case incurred losses while today the premiums in force appears to be the favorite base, although reasonable arguments can be marshalled for other bases.

One of the many things which should be considered when selecting an exposure base is the potential distortion in the IBNR reserve which can occur if the book of business is growing rapidly (especially a new book of business). This problem arises because: "we would expect losses to be incurred roughly in proportion to the number of policies in force and, since there are more policies in force at the end of a given accounting period than at the beginning of the period, a factor which measures the incurred but not reported (IBNR) losses will be influenced (that is distorted) by the relatively heavier weight of policies in force at the end of the accounting period".[2] The various solutions to this problem, arrived at by means of geometric modeling, are discussed in detail by Mr. Simon and his reviewer, Charles F. Cook, and will not be discussed here.

1 Tarbell, Thomas F. "Incurred But Not Reported Claim Reserves," *Proceedings of the Casualty Actuarial Society*, Vol. XX, 1934, p. 275

2 Simon, LeRoy J., "Distortion in IBNR Factors," *Proceedings of the Casualty Actuarial Society*, Vol. LVII, 1970, p. 64

This distortion can be a very real problem, and is partly a function of the base used, the term of the business, and the tail of the business (i.e. loss distribution over time). Fortunately, the distortion is relatively less significant on the heavy IBNR lines since they are normally short term policies of 6 months or 1 year, and these lines have a long tail. Mr. Cook points out, in his review, that the choice of the base can also help to minimize the possible distortions and that, for this and other reasons, he favors premiums in force or earned premium as a base.

If one is establishing reserves for a fast closing line, such as the property lines where there is practically no development after 24 months (e.g. 1972 accident year incurred losses as known at 12/31/73) there is absolutely nothing wrong with a Tarbell type of approach. On the other hand, if development is expected after 24 months, as is probable for the Schedule P lines, a more rigorous actuarial approach is indicated.

A one year run-off method, such as Tarbell's, will lead to a woefully inadequate reserve structure if loss development patterns are deteriorating (almost a certainty in the face of modern inflation) and especially if the volume of business is increasing.

For example:

$$\frac{\text{1969 IBNR Observed}}{\text{1969 Premium In Force}} = \frac{\$\ 1{,}000{,}000}{\$10{,}000{,}000} = .10$$

$$\frac{\text{1970 IBNR Observed}}{\text{1970 Premium In Force}} = \frac{1{,}500{,}000}{13{,}000{,}000} = .1154$$

$$\begin{aligned}\text{1971 IBNR Reserve} &= 11.54\% \times \text{1971 Premium In Force}\\ &= 11.54\% \times \$16{,}900{,}000\\ &= \$1{,}950{,}000\end{aligned}$$

We would expect, based on 1969 experience, that the numerator for the 1970 calculation would be $1,300,000, an increase of $300,000 and in line with the increased exposure. But an "extra" $200,000 of development has surfaced. If the extra $200,000 of development is due to a deterioration in the 3rd to 4th report and exposure has been increasing 30% per year, the 1971 IBNR reserve should be $3,039,000 rather than $1,950,000.

The snowballing effect of a deterioration in loss development patterns can best be appreciated by viewing the IBNR reserve structure as it really is, a function of past and present exposures, and not as it seems to be in terms of a Tarbell type formula. The Tarbell formula would lead us to believe that IBNR is totally a function of the in force or incurred, at a given point in time. In reality, the IBNR at time t is partially a function of the claims or exposure relevant to accident year t, and partially a function of claims or exposure relevant to accident year t-1, t-2, etc. If circumstances change so that more development is expected on year t-4, there will also, *ceteris paribus*, be an effect on accident years t-3, t-2, t-1 and t as they ultimately play out.

Loss Development Approach

Determination of Loss Development Factors

The starting point in the establishment of a complete IBNR reserve is the study of developments on total incurred losses on an accident year basis. To facilitate this type of review, it is necessary that all loss and allocated loss expense data carry both accident date and (original) notification date. The authors have found that month and year serve as adequate identification, and that the month identification is essential for the more sophisticated reserving techniques discussed in a later section.

Having studied the emerging loss development data, and resulting loss development factors for the various reporting intervals (first to second report, second to third report, etc.), it is a relatively simple matter to construct an IBNR reserve. Normally, the individual loss development factors would be those indicated by averaging the development patterns for several years, and possibly making judgment adjustments to reflect trends apparent in the data. It is, of course, possible to attempt to select loss development factors in a more objective manner by smoothing the resulting IBNR factors (i.e. unity less the reciprocal of the loss development factor to ultimate) with a fitted curve. Thomas W. Fowler found that a modified exponential curve fitted the IBNR factors reasonably well for the data he was reviewing.[3]

On the attached exhibits we display a purely hypothetical IBNR reserve computation procedure. Exhibit A portrays the actual case loss developments along with the individual loss development factors by interval. In the left column, as a point of reference, the earned premiums net of

3 Fowler, Thomas W., *IBNR*, "Liability IBNR Reserves" p. 35 and Exhibit C, published by Nederlandse Reassurantie Groupe, N.V. Amsterdam, 1972.

commission for the calendar year associated with each accident year are displayed. This is the basic tool with which the IBNR reserve is developed.

IBNR Reserve Computation

The attached Exhibit B sets forth the actual IBNR reserve computation based upon the data in Exhibit A. After determining the loss development factors to ultimate (column 4), one could simply apply these factors to the appropriate case incurred losses, although, in some cases, working backwards from expected losses to an IBNR reserve is the recommended procedure. This is accomplished by subtracting the reciprocal of the appropriate loss development factor from unity and applying the resulting factors to the accident year expected losses.

The decision as to whether to develop the reserve as a direct function of case incurred losses or as a function of expected losses turns on the expected volatility of the data. If the data are extremely thin, the presence or absence of several large losses will impact greatly on the IBNR reserves if the reserve is a function of the case incurred. A strictly fortuitous event such as an exceptionally large loss should not be allowed to distort the IBNR reserves. Then too, if one is working with an unusual line with a long tail, or perhaps simply a new line, it might be desirable to derive the IBNR as function of expected losses. It can be argued that the most prudent course is, when in doubt, to use expected losses, inasmuch as it is certainly indicated for volatile lines, and in the case of a stable line, the expected loss ratio should be predictable enough so that both techniques produce the same result.

A more comprehensive explanation of Exhibit B follows:

> To produce average loss development factors for each interval (one report to the next) the latest three years of data were used. Columns (1) and (2) are the basic data from the loss development triangle (Exhibit A). For example, the sum of the first reports for accident years 1968, 1969 and 1970 is $10,250,000 while $14,500,000 is the sum of the incurred losses as of the second report for those same three accident years. The division of these figures produces the average loss development factor of 1.415 shown in column (3).

Column (4) is simply the upward accumulation of the column (3) loss development factors which will then produce the total loss development factor to project a given accident year to its estimated ultimate result. The factor from third report to ultimate is obtained by multiplying 1.000 x 1.032, while the factor 1.166 from second to ultimate, is the product of 1.000 x 1.032 x 1.130.

The expected losses for each accident year are set forth in column (6). In the example, they are obtained by applying an expected loss ratio of 95% to the premiums earned net of commissions from Exhibit A. The 95% reflects a 5% adjustment to eliminate estimated overhead costs. The selection of an expected loss ratio also is affected by the stability of the data. If for example, a company demonstrates that it can consistently produce an ultimate loss ratio of 60%, then that, to be sure, is the ratio to be used in the IBNR calculations. On the other hand, if the expected loss ratio cannot be selected with much accuracy, a high ratio should be used on the assumption that it is better to err on the conservative side (but not so conservative as to run afoul of the Internal Revenue Service). In rare instances, one might deem that an expected loss ratio exceeding 100% would be appropriate.

Column (7) sets forth the conversion of the loss development factors in column (4) to a basis appropriate for use with expected losses. The factor of .394 for accident year 1971 indicates that 60.6% of the total losses for that accident year have been reported as of the first report (12/31/71), and thus that 39.4% of the losses are yet to emerge. The factor of .394 is determined as follows:

$$\begin{aligned} \text{IBNR factor} &= 1.000 - 1.000/\text{loss development factor to ultimate} \\ &= 1.000 - 1.000/1.650 \\ &= .394 \end{aligned}$$

The IBNR reserves are set forth in column (8) and are the product of the IBNR factors in column (7) and the expected losses in column (6). Thus $2,994,000 is the IBNR reserve assigned to accident year 1971, while $1,012,000 is allocated to accident year 1970, and $206,000 for accident year 1969, resulting in a total reserve of $4,212,000 at 12/31/71.

The technique for developing the IBNR reserve as a function of case incurred losses, Column (9), Exhibit B, involves applying the loss development factor, Column (4), Exhibit B, less unity to the proper case incurred losses (e.g. $4,250,000 x .65; $4,800,000 x .166 etc.). A refinement, results shown in Column (10), on the above method, which is sometimes used to "smooth out" the data, is to average the case incurred for the same report, say for two years; adjust that average case incurred figure to reflect the relative difference between the average exposure for the two years studied and the current year; times the IBNR factor e.g.:

$$\frac{(4{,}250{,}000 + 3{,}300{,}000)}{2} \times \frac{8{,}000{,}000}{\frac{(7{,}500{,}000 + 8{,}000{,}000)}{2}} \times .65 = \$2{,}533{,}000$$

$$\frac{(4{,}800{,}000 + 5{,}200{,}000)}{2} \times \frac{7{,}500{,}000}{\frac{(7{,}000{,}000 + 7{,}500.000)}{2}} \times .166 = \$859{,}000$$

In our example, each method produced a different IBNR reserve. The first method (IBNR reserve as a function of expected losses) could be brought more into line with the other two methods if it was felt that a lower expected loss ratio could be justified. If the ultimate loss ratio to premiums earned net of commission was completely predictable, all three methods would produce the same reserve. Of course, if loss ratios were that predictable, the determination of IBNR reserves would be a trivial matter. One would simply subtract the incurred losses to date by accident year from the expected ultimate incurred, the remainder being the needed IBNR reserve.

Homogenous Data

It makes sense to perform the loss development reviews and IBNR calculations independently for types of business which are known or thought to be different. For example, automobile liability loss development patterns are different than those observed for workmen's compensation. Commercial business may very well have different loss development characteristics than personal business. Umbrella business will clearly have a different loss development pattern than general liability. On the other hand, combining B.I. and P.D. might make sense, especially in light of the recent Annual Statement changes, especially since the B.I., P.D. mix is not likely to change significantly over short periods of time.

The product mix can be an important factor, not so much because two somewhat dissimilar items are combined, but because they may have different rates of growth. For example, a company may have personal and commercial automobile loss development experience combined over the years although, if it were looked at separately, commercial business would require higher loss development factors. As long as the relative exposure between the two categories remains constant there is no problem; however, picture the situation if personal automobile increased at a 5% annual rate while commercial automobile, although relatively small, is growing at a 25% annual rate. The reader may wish to construct a model along these lines and he will be surprised with the results.

Of course, the volume of data is an important factor in determining what kind of breakdowns of the data are feasible. If the data are subdivided so finely that most groups have only a small volume of data, the subdivisions may accomplish nothing useful. Or to quote Mr. Longley-Cook's delightful analogy, "We may liken our statistics to a large crumbly loaf cake, which we may cut in slices to obtain easily edible helpings. The method of slicing may be chosen in different ways—across the cake, lengthwise, down the cake, or even in horizontal slices, but only one method of slicing may be used at a time. If we try to slice the cake more than one way at a time, we shall be left with a useless collection of crumbs" [4]

INTERIM RESERVING TECHNIQUES

Between the annual calculations of an IBNR reserve structure it is necessary to periodically review the reserve from two angles. At the close of each accounting period it must be determined if changes in the amount of the reserve are necessitated by changing exposures. Secondly, the reserves established at the prior year-end must be continuously monitored to see if the loss developments observed are what were contemplated when the reserve was established. To the extent that the actual development is different from the expected and credible, the reserve structure should be "fine-tuned".

It is a relatively easy matter to determine the amount of development

4 Longley-Cook, Lawrence, H., "An Introduction to Credibility Theory," *Proceedings of the Casualty Acturial Society*, Vol. XLIX, 1962, p. 194.

expected in the year following the establishment of the reserve. The IBNR reserve, for a given accident year multiplied by a factor, which is developed by dividing the loss development factor for the period (e.g. second to third) minus unity by the ultimate loss development factor (e.g. second report to ultimate) minus unity, will produce the amount of development expected during the ensuing calendar year (for that accident year). In Exhibit B, the expected development in 1972 on the 1971 accident year would be derived as follows:

$$\frac{1.415 - 1.000}{1.650 - 1.000} \times \$2{,}994{,}000 = \$1{,}911{,}669$$

A summation of similar calculations over all accident years produces the total expected development for the calendar year.

If an IBNR computation tied to expected losses rather than actual losses is employed, the determination of the expected development is a little easier. The expected losses for a given accident year multiplied by the difference between that year's and the previous year's IBNR factor will produce the expected development for the next calendar year. Referring again to Exhibit B, the 1971 accident year development would be: $7,600,000 × (.394 − .142) = $1,915,000. Of course, algebraically, we are accomplishing the same thing and it is only rounding errors that cause the resulting numbers to be slightly different.

Having determined the expected development for the year, the next step is to allocate the expected development to quarters. Here one can make judgments or rely on empirical studies. In the absence of data, it might be reasonable to assume that the cummulative distribution of development by quarter for the most recent accident year is skewed say 40% at three months, 70% at six months, 85% at nine months, 100% at 12 months, and that the distribution for prior accident years is uniform: 25%, 50%, 75% 100%. Upon further study the authors were somewhat surprised to find that their data revealed prior year's development were also skewed; approximate distribution: 33%, 60%, 80%, 100%. The data reviewed were excess of loss and it is recognized that distributions observed may not be typical of ordinary business.

If the quarterly (or perhaps semi-quarterly) monitoring indicates a deterioration, it is necessary to pay attention to where, in terms of accident years, the deterioration exists. If the deterioration occurs in an old accident year one must consider the possible snowballing effect alluded to in the first part of the paper.

Changes in exposure and the concomitant changes in reserves can be handled in a variety of ways. The simplest and most treacherous is to relate the entire reserve to the current year's net earned premium and then apply the resulting factor to the increase or decrease in exposure (at 6/30, this would be the difference between 12 months earned premium at 12/31 and 12 months earned premium as of 6/30; this, of course, simplifies to the difference between earned premium for the first six months of each year). This technique will be quite satisfactory as long as the exposure is increasing or decreasing at a uniform rate (see Exhibit C) but will be considerably wide of the mark if the growth rate varies.

A more refined approach to reserve increases due to exposure changes would take into account varying growth rates. One such approach would be to estimate what the IBNR reserve would be at the end of next year (assuming no change in loss development patterns) if next year's exposure is the same as this year's exposure. In Exhibit A, such a calculation would show that a reserve of $4,295,000 would be necessary. The increment could be budgeted by quarter and then if the exposure as of the interim date appeared to be up, the increment in expected losses would be multiplied by the current years IBNR factor (.394 in the example). This latter approach should result in a fairly orderly change in the reserve over the year.

FISCAL/ACCIDENT YEAR APPROACH

Perhaps the ultimate answer for establishing interim point INBR reserves is a fiscal/accident year system. Working from a fiscal/accident year data base it is possible to create at the close of each quarter a completely new IBNR reserve structure. This procedure will automatically take into account any credible changes in loss development patterns and it will all be keyed to current exposure levels.

Admittedly, creating a fiscal/accident year data base could be expensive and, obviously, the more involved computation procedures will be more time consuming than the rough hewn interim procedures described in the preceding section. Unquestionably, a better product will be produced, although it is recognized that unless the reserves involved are substantial in relation to surplus it may be difficult to justify the effort.

A fiscal/accident year embraces losses which occur in the twelve months running (for example) from 4/1 to 3/30. These losses would be evaluated as of second report (12 months later), third report (24 months later), etc. Loss development triangles similar to Exhibit A would then be assembled. Expected losses, as a function of earned premium, are developed on a fiscal year basis and IBNR calculations would proceed as in Exhibit B.

Conclusion

As in so many areas of actuarial endeavor, the setting of IBNR reserves is far from an exact science. As was made clear in the above presentation, there are numerous judgments which have to be made by the individual responsible for the reserves. The methods available range from the crude techniques discussed in the first section to the relatively sophisticated fiscal/accident year approach described in the last section.

No matter what approach is taken, one must be ever mindful of the fact that the forces which operate on the IBNR liabilities are dynamic and frequently will beyond the control of the company. A list of the many factors, internal and external, which will affect IBNR includes: inflation, claims adjusting philosophy, processing lags, no-fault programs, reinsurance arrangements, court back logs, product mix, etc. The list can be very long and, as an illustration of the unusual situations which can occur, a special IBNR reserve at March 31, 1970 was established in our own company to anticipate the effects of the mail strike in effect at that time.

It is hoped that more casualty actuaries will involve themselves in this important area. IBNR reserves deserve more than just a clerical or cursory treatment and we believe, as did Mr. Tarbell, that "the problem of incurred but not reported claim reserves is essentially actuarial or statistical". [5] Perhaps in today's environment the quotation would be even more relevant if it stated that the problem " . . . is more actuarial than statistical".

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5 Tarbell, *op. cit.*, p. 276.

HYPOTHETICAL LOSS DEVELOPMENT DATA

Exhibit A

Earned Premiums Net of Commission	Accident Year	Incurred Case Losses (including Allocated Claim Expense) First Report	Second Report	Third Report	Fourth Report	Fifth Report	Sixth Report
$5,000,000	1966	$2,500,000	$3,650,000	$4,200,000	$4,325,000	$4,335,000	$4,330,000
			1.460	1.151	1.030	1.002	.999
5,500,000	1967	2,150,000	3,225,000	3,775,000	3,965,000	3,960,000	
			1.500	1.171	1.050	.999	
6,000,000	1968	3,250,000	4,500,000	5,050,000	5,150,000		
			1.385	1.122	1.020		
7,000,000	1969	3,700,000	5,200,000	5,775,000			
			1.405	1.111			
7,500,000	1970	3,300,000	4,800,000				
			1.455				
8,000,000	1971	4,250,000					

Exhibit B

HYPOTHETICAL IBNR RESERVE COMPUTATION

Dev. Period	(1) Three Year Data: Beginning	(2) Three Year Data: Ending	IBNR Computation as of Dec. 31, 1971: (3) Loss Dev. Factor: Indicated	(4) Loss Dev. Factor: To Ult.	(5) Accident Year	(6) Expected Losses φ	(7) Expected Losses IBNR Factor#	(8) Indicated IBNR	(9) Loss Method IBNR	(10) Adjusted Loss Method IBNR
1st-2nd	$10,250,000	$14,500,000	1.415	1.650	1971	$7,600,000	.394	$2,994,000	$2,763,000	$2,533,000
2nd-3rd	12,925,000	14,600,000	1.130	1.166	1970	7,125,000	.142	1,012,000	797,000	859,000
3rd-4th	13,025,000	13,440,000	1.032	1.032	1969	6,650,000	.031	206,000	185,000	186,000
4th-Ult.	8,290,000*	8,290,000*	1.000	1.000	1968	5,700,000	—	-0-	-0-	-0-
								$4,212,000	$3,745,000	$3,583,000

*Only two years of data
φEarned Premium (net of commission) × .95
#Factor = 1.000 − 1.000/ultimate loss development factor

Exhibit C

HYPOTHETICAL IBNR COMPUTATION

	As Of 12/31/71			As Of 12/31/72		
	Expected Losses	IBNR Factor	IBNR Reserve	Expected Losses	IBNR Factor	IBNR Reserve
1966	$1,000,000	−.062	$ −62,000	$ —	—	—
1967	1,200,000	−.014	−17,000	1,200,000	−.062	$ 74,000
1968	1,440,000	.078	112,000	1,440,000	−.014	−20,000
1969	1,728,000	.232	401,000	1,728,000	.078	135,000
1970	2,074,000	.535	1,110,000	2,074,000	.232	481,000
1971	2,488,000	.814	2,025,000	2,488,000	.535	1,331,000
1972				2,986,000	.814	2,431,000
Total	$9,930,000		$3,569,000	$11,916,000		$4,284,000

Increase in the current year's exposure is $498,000 ($2,986,000 − $2,488,000). Increase in total IBNR is $715,000 ($4,284,000 − $3,569,000).

The increase in IBNR reserve can be developed by applying the ratio of the 12/31/71 IBNR to the 1971 premiums to the increase in expected losses. For example, $3,569,000/$2,488,000 = 1.435 and 1.435 × $498,000 = $715,000.

At first glance it seems odd that the increase in the IBNR reserve ($715,000) would be greater than the increase in exposure ($498,000). This phenomenon results from the fact that it is not only the current year exposure that is increased but each of the prior years is also increased (e.g. the 1st prior year to which a factor of .535 applies has increased from $2,074,000 to $2,488,000). To put it in another way, while 1972 exposure has increased by $498,000 over 1971, the total exposure subject to an IBNR factor has increased by $1,986,000 ($11,916,000 − $9,930,000).

Assumptions: Premium growth rate of 20%, expected losses are a direct function of premiums earned, IBNR factors unchanged. (Factors shown above are much higher than the factors found in Exhibit B and are typical of what can be expected on excess of loss business).