RESERVING FOR RETROSPECTIVE RETURNS

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INTRODUCTION

This paper discusses possible approaches to the problem of establishing reserves for retrospective returns for the annual statement and for statements of company operating results. The first of the formulas explained has produced satisfactory results when applied to the data of one company for policy years from 1956 to 1962. The reserves established by the methods described in this paper do not lend themselves readily to run-off tests. The reasons these reserves are difficult to test and the method which should be used for testing will be discussed in the paper.

AMOUNT OF THE RETROSPECTIVE RETURN RESERVE

An insurance company must display the retrospective return reserve in Column (6) of Part 2B of its annual statement, thus including the amounts in the unearned premium reserve. The retrospective return reserve may be made up of the following two amounts:

1. The net return premium which would be due to policyholders as a result of making retrospective adjustments using premiums and losses as contained in company records as of the statement date for all retrospectively rated risks for which final adjustments have not yet been calculated.
2. The premium due to policyholders as of the statement date as a result of final adjustments which have been calculated but not yet recorded on the company's books.

NEGATIVE RESERVES

Should the retrospective return reserve calculation indicate that additional premiums will be due the company as a result of retrospective adjustments, it is appropriate that the company include negative retrospective reserves in its annual statement. It is only by permitting reserves to become negative that the proper underwriting profit for the calendar year can be reflected.

CHARACTERISTICS OF A GOOD RESERVING METHOD

A system for determining the reserve for retrospective returns should meet the following objectives:

1. The amount of the reserve should be the best estimate of the

probable run-off of retrospective returns, in consideration of premiums recorded as earned and losses known and estimated at the time the reserve is established.

2. The total reserve can be considered to be composed of the sum of a reserve for each line of insurance for each policy year. Each such portion of the reserve should move gradually from the beginning of a policy year (January) to a maximum (absolute value) at about 20 months (August of the second calendar year), and then should gradually go to zero as retrospective returns are disbursed. Throughout the entire life of the reserve for each line for each policy year, the monthly changes should appropriately reflect monthly changes in earned premium, incurred losses and deviation payments, so that underwriting results will not be distorted.
3. At some point in time the reserve for each line for each policy year should become zero. Determination of when this point in time is reached may be somewhat arbitrarily set as the point at which any further reserve, if carried, would be small, equally likely to be plus or minus, and probably unreliable.
4. The reserve produced by the system should be a net reserve, i.e., the net of retrospective return and retrospective additional premiums, for appropriate effect on underwriting results. However, to meet the requirements of any Insurance Department that requires a company to calculate a reserve for returns only, the system must also be able to determine an appropriate reserve for returns only.
5. The method should allow a reserve to be calculated quickly enough to be used for company results; data actually collected to the end of the accounting period should be the basis for the calculation. The relatively short time available between receipt of the data and the necessary completion of the reserve calculation probably rules out a risk by risk calculation for most companies although companies using computers may be able to use this method.

DATA REQUIRED FOR THE CALCULATION

Written premiums, written restrospective adjustment premiums, unearned standard premiums and incurred losses are required by line of business and by policy year. These data must be gathered as frequently as reserves are to be calculated for company results and always at year-end.

FORMULA FOR RESERVING

It seems logical that the reserve for retrospective returns should vary with the loss ratio, increasing when the loss ratio declines and declining, even to becoming negative, when the loss ratio increases.

A monthly calculation of a reserve for Workmen's Compensation will illustrate one method which produces retrospective return reserves which vary with loss ratios.

The following Table I shows policy year experience for retrospectively rated Workmen's Compensation business.

Table I

Ætna Casualty & Surety Company Experience Under
Retrospectively Rated Workmen's Compensation Policies

All Policy Years Valued as of 6-30-64
(Thousands of Dollars)

Policy Year (1)	Earned Standard Premium (2)	Incurred Losses (3)	Loss Ratio (4) (3)÷(2)	Retrospective Adjustment Premium (Deviations) (5)	Deviation Ratio (6) (5)÷(2)
1958	24,552	14,447	58.84%	3,726	15.18%
1959	27,359	17,058	62.35	3,350	12.24
1960	29,864	18,904	63.30	4,204	14.08
1961	36,439	21,612	59.31	5,685	15.60
1962	41,956	24,724	58.93	6,575	15.67

Notes:

1. Earned Standard premium includes all premium written for policies which contain retrospectively rated premium i.e. total policy premium would be included even though some premium contained on the policy is not subject to retrospective rating.
2. Incurred losses include all losses paid and unpaid for policies which have contributed their premium to Column (2). The losses contain reserves for incurred but not reported losses omitting losses which are expected to emerge after all retrospective adjustments for the policy year have been considered final. Losses are included at full value and the effect of the loss limitations of the retrospective plans has been ignored. Our studies indicate that little loss of accuracy results from using total losses, and total data are much simpler to gather.

Assuming that such a relationship exists between the loss ratio and the deviation ratio that one increases while the other decreases, a least squares line has been fitted to the data contained in Table I.

With the loss ratio represented by X and the deviation ratio by Y, the equation is:

$$Y = .472 - .539\,X$$

This can be changed to the form:

Indicated deviation =
(.472) Earned standard premium − (.539) Incurred losses

Knowing the premiums and losses each month, an indicated deviation can be calculated. This indicated deviation is compared to the actual deviation premiums recorded to date and the difference held as the reserve.

CALCULATION OF RESERVES FOR POLICY YEAR 1958

Exhibit I shows a sample calculation of a reserve for policy year 1958 at each month end from January 1958 to June 1964.

DIFFICULTY OF A RUN-OFF TEST OF THIS RESERVE

The formula deviation would be expected to reproduce the experience exactly only if losses had been estimated exactly and all premiums earned for policy years prior to the most recent year had been included in company records. Since much earned premium is reported late—audits for example—and since it is impossible to predict losses exactly, formula deviations for each policy year will change as the experience matures.

The reserve for the most recent policy year at year-end is based on incomplete data, a partial policy year, and the actual deviations would equal the formula deviation only if all policies were terminated as of the statement date and the conditions described for prior policy years were fulfilled. As a company continues operations, the premiums earned and losses incurred for the remainder of the policy year add to the data entering the formula. There would be no practical way to test a portion of the policy year.

When the reserve at 12-31-59 was calculated (Exhibit I), ultimate deviations of $3,503,805 were predicted. To June 30, 1964, $3,726,224 were actually returned. At 12-31-59, the loss ratio was 60.7% and premiums earned were $24,213,757. Since that time, late reported premiums have totaled $338,553 and the loss ratio has dropped 1.9 points; both changes have increased the returns and distorted the runoff test.

If excessive loss reserves are held, retrospective return reserves produced by this formula are depressed. Revaluing losses and lowering them should produce more returns. When premiums increase for a policy year,

again more returns should be produced. The fact that the formula deviation is not reproduced does not necessarily mean the reserve formula did not work properly. It may only prove that the formula depends for its validity on the accuracy of the data entering into the calculation.

If excessive loss reserves are held, the direct effect will be to understate underwriting gain and the indirect effect through understatement of the retro reserve will be to overstate underwriting gain; thus, an error in the evaluation of losses will give rise to an error of opposite direction in the retro reserve and thereby dampen the effect on underwriting gain.

If earned unreported premiums could be estimated and included in premium income, and if incurred losses could be accurately estimated, a retrospective reserve could be calculated which would be expected to reproduce the ultimate deviations. Since earned unreported premiums cannot be included in premium income, the retro reserve is more truly a measure of what must be set aside out of reported income than a measure of what ultimately will be paid.

The proper way to examine the reserves established by the methods described here begins with a review of the characteristics of the method. The following questions should be answered:

1. Did the same formula, or the formula in use at the time, produce reserves of zero for older policy years several year-ends beyond the end of each policy year?
2. Have the data underlying the present formula been verified and are these data up-to-date?
3. Has the equation developed from the data been tested for goodness of fit?
4. Do changes in premium volume and loss ratio account for the difference between the present reserve level for a policy year and the level of prior policy years at the same age?

If an examiner agrees with the general principles and these questions have been satisfactorily answered, the reserves held may be assumed to have been reasonable. The appropriate tests are mainly of method and formula and not run-off tests of the answers.

OTHER RESERVING FORMULAS

From Table I, it can be observed that for the two most recent policy years 15.60% and 15.67% have been returned to policyholders. A reserve

EXHIBIT 1

RESERVES FOR POLICY YEAR 1958
WORKMEN'S COMPENSATION

Date	Earned Standard Premium	Incurred Losses	Loss Ratio	Indicated Deviation	Deviation Payments	Retrospective Return Reserve
(1)	(2)	(3)	(4)	(5) .472 (2) — .539 (3)	(6)	(7)
1-58	48,873	219,456	4.490	— 95,219	0	— 95,219
2-58	341,501	606,657	1.776	— 165,800	0	— 165,800
3-58	970,886	959,287	.988	— 58,798	0	— 58,798
4-58	1,965,507	1,868,034	.950	— 79,151	0	— 79,151
5-58	3,101,186	2,525,315	.814	102,615	0	102,615
6-58	4,293,575	3,550,857	.827	112,655	0	112,655
7-58	5,742,469	4,430,602	.772	322,351	0	322,351
8-58	6,903,355	5,504,474	.797	291,472	0	291,472
9-58	8,289,701	6,385,123	.770	471,158	0	471,158
10-58	10,469,528	7,917,996	.756	673,817	0	673,817
11-58	13,230,451	8,503,872	.643	1,661,186	0	1,661,186
12-58	14,723,978	9,929,790	.674	1,597,561	0	1,597,561
1-59	16,524,513	10,748,103	.650	2,006,343	2,124	2,004,219
2-59	17,743,166	11,128,578	.627	2,376,471	— 4,767	2,381,238
3-59	18,712,852	12,187,908	.651	2,263,184	— 4,767	2,267,951
4-59	19,720,306	12,582,782	.638	2,525,865	— 5,013	2,530,878
5-59	20,777,043	13,046,836	.628	2,774,520	— 5,160	2,779,680
6-59	21,529,638	13,514,331	.628	2,877,765	— 3,054	2,880,819
7-59	22,298,087	13,942,448	.625	3,009,718	6,634	3,003,084
8-59	22,937,661	14,038,745	.612	3,259,692	31,137	3,228,555
9-59	23,313,567	14,307,320	.614	3,292,358	247,812	3,044,546
10-59	23,532,656	14,438,825	.614	3,324,887	628,988	2,695,899
11-59	24,128,247	14,687,860	.609	3,471,776	1,231,380	2,240,396
12-59	24,213,757	14,703,318	.607	3,503,805	1,450,858	2,052,947
1-60	24,348,037	14,730,053	.605	3,552,775	1,678,470	1,874,305
2-60	24,431,671	14,917,900	.611	3,491,001	2,182,359	1,308,642
3-60	24,519,386	15,020,731	.613	3,476,976	2,336,521	1,140,455
4-60	24,584,549	15,083,072	.614	3,474,131	2,683,030	791,101
5-60	24,602,208	15,171,746	.617	3,434,671	2,822,311	612,360
6-60	24,676,964	15,191,695	.616	3,459,203	3,194,782	264,421
7-60	24,600,050	15,219,361	.619	3,407,988	3,975,650	— 567,662
8-60	24,597,037	15,181,773	.617	3,426,826	4,084,234	— 657,408
9-60	24,593,690	15,168,438	.617	3,432,434	4,145,569	— 713,135
10-60	24,581,555	15,239,416	.620	3,388,449	4,122,280	— 733,831
11-60	24,578,541	14,848,863	.604	3,597,534	4,122,253	— 524,719
12-60	24,582,891	14,781,496	.601	3,635,898	4,140,417	— 504,519

EXHIBIT 1

RESERVES FOR POLICY YEAR 1958
WORKMEN'S COMPENSATION—Continued

Date	Earned Standard Premium	Incurred Losses	Loss Ratio	Indicated Deviation	Deviation Payments	Retrospective Return Reserve
(1)	(2)	(3)	(4)	(5)	(6)	(7)
				.472 (2) — .539 (3)		
1-61	24,585,706	14,784,871	.601	3,635,408	4,078,807	— 443,399
2-61	24,587,919	14,939,962	.608	3,552,858	4,018,580	— 465,722
3-61	24,580,671	14,948,369	.608	3,544,906	3,976,628	— 431,722
4-61	24,581,123	14,500,604	.590	3,786,465	4,049,434	— 262,969
5-61	24,581,615	14,550,033	.592	3,760,054	4,038,984	— 278,930
6-61	24,578,227	15,237,426	.620	3,387,951	3,930,467	— 542,516
7-61	24,579,354	15,344,455	.624	3,330,794	3,910,376	— 579,582
8-61	24,579,177	15,398,985	.627	3,301,319	3,936,715	— 635,396
9-61	24,579,177	15,445,477	.628	3,276,259	3,937,706	— 661,447
10-61	24,579,177	15,374,827	.626	3,314,340	3,895,927	— 581,587
11-61	24,579,177	15,429,452	.628	3,284,897	3,769,020	— 484,123
12-61	24,579,177	15,448,617	.629	3,274,567	3,723,231	— 448,664
1-62	24,579,177	15,396,856	.626	3,302,466	3,715,428	— 412,962
2-62	24,579,177	15,401,391	.627	3,300,022	3,647,753	— 347,731
3-62	24,579,177	15,383,646	.626	3,309,586	3,593,909	— 284,323
4-62	24,579,177	15,377,494	.626	3,312,902	3,544,057	— 231,155
5-62	24,578,149	15,412,716	.627	3,293,432	3,545,993	— 252,561
6-62	24,578,149	15,384,335	.626	3,308,729	3,504,021	— 195,292
7-62	24,573,188	15,420,734	.628	3,286,769	3,487,615	— 200,846
8-62	24,573,188	15,417,290	.627	3,288,625	3,476,186	— 187,561
9-62	24,572,407	15,388,670	.626	3,303,683	3,436,465	— 132,782
10-62	24,553,614	15,291,317	.623	3,347,286	3,474,370	— 127,084
11-62	24,553,498	15,315,849	.624	3,334,008	3,456,161	— 122,153
12-62	24,553,498	15,255,367	.621	3,366,608	3,473,035	— 106,427
1-63	24,553,498	15,099,592	.615	3,450,571	3,449,320	1,251
2-63	24,553,498	15,151,851	.617	3,422,403	3,510,675	— 88,272
3-63	24,553,498	15,082,159	.614	3,459,967	3,532,441	— 72,474
4-63	24,553,498	15,070,661	.614	3,466,164	3,517,778	— 51,614
5-63	24,553,498	15,083,138	.614	3,459,440	3,525,330	— 65,890
6-63	24,553,498	14,912,758	.607	3,551,274	3,566,941	— 15,667
7-63	24,553,498	14,793,725	.603	3,615,433	3,560,924	54,509
8-63	24,553,498	14,788,648	.602	3,618,170	3,573,301	44,869
9-63	24,553,498	14,790,984	.602	3,616,911	3,588,039	28,872
10-63	24,553,498	14,748,939	.601	3,639,573	3,641,677	— 2,104
11-63	24,553,498	14,741,103	.600	3,643,797	3,656,103	— 12,306
12-63	24,553,498	14,698,789	.599	3,666,604	3,619,253	47,351
1-64	24,553,498	14,672,364	.598	3,680,847	3,658,181	22,666
2-64	24,553,498	14,623,380	.596	3,707,249	3,653,977	53,272
3-64	24,552,318	14,592,927	.594	3,723,106	3,658,617	64,489
4-64	24,552,310	14,564,483	.593	3,738,434	3,671,060	67,374
5-64	24,552,310	14,537,192	.592	3,753,144	3,688,916	64,228
6-64	24,552,310	14,446,331	.588	3,802,118	3,726,224	75,894

could be developed by applying a factor of 16%, for example, to earned standard premium, comparing this indicated return to the actual return and carrying the difference as the reserve. This method is simpler to use than the earlier formula but ignores the effect of changes in loss ratio on the reserve. In a period of worsening experience, we would continue to build a large reserve, and in a period of improving experience the reserve would not be large enough.

To develop our next formula, let us suppose that all retrospectively rated business operates the same as one large risk. Only countrywide averages of basic premium ratios, tax multipliers, loss conversion factors, loss limitation charges and a factor to reduce total losses to losses which enter the retro calculation would be required to calculate a reserve. For example, using the following averages which were obtained from an analysis of retrospectively rated one year policies for policy years 1959-1961:

Basic premium ratio including loss limitation charge	.197
Tax multiplier	1.026
Loss conversion factor	1.140
Losses exceeding loss limitation	.019
Losses exceeding maximums minus losses under minimums	.043

The reserving formula will be:

$$\text{Retro premium} = \text{Tax mult.}\ (\text{Basic} \times \text{Std. prem.} + \text{LCF} \times \text{Losses} \times \text{Limitation factor})$$

$$\text{Deviation} = \text{Standard premium} - \text{Retro premium}$$

$$\text{Reserve} = \text{Indicated deviation} - \text{actual deviations}$$

At 12-59, the reserve for policy year 1958 would have been calculated as follows:

$$\text{Retro premium} = 1.026\ (.197 \times 24{,}213{,}757 + 1.140 \times .938 \times 14{,}703{,}318) = 21{,}025{,}471$$

$$\text{Deviation} = 24{,}213{,}757 - 21{,}025{,}471 = 3{,}188{,}286$$

$$\text{Reserve} = 3{,}188{,}286 - 1{,}450{,}858 = 1{,}737{,}428$$

This $1,737,428 compares to $2,052,947 using the earlier formula (Exhibit I).

While this method may give satisfactory results, it is more difficult to use than the least squares approach mainly because it is difficult to keep the required average factors up to date.

LINES OF BUSINESS FOR WHICH THE FORMULA APPROACH SEEMS APPROPRIATE

While retrospective rating is presently being used in the auto physical damage, inland marine, fidelity and burglary lines, other reserving methods are better in those lines than the formula approach because of the small volume. The formula approach seems to be suitable for:

Workmen's compensation
Auto liability B.I. & P.D.
Liability other than Auto B.I. & P.D.

ALTERNATIVE APPROACHES TO RESERVING

A reserve may always be created through use of judgment alone. Using judgment is certainly the simplest method since no calculations are required, and this may be a satisfactory approach for a very small volume of retrospectively rated business. For a line with a few retrospectively rated risks, a risk by risk calculation may be made at each month-end using premium earned and losses incurred to the reserve date. Basic premium ratios and maximum and minimum ratios should be selected for the size of the premium earned to date.

CONVERSION OF NET RESERVE TO RETURNS ONLY RESERVE

Some Insurance Departments may require that retrospective return reserves be established for *returns only*. This means that if one insured has some lines or policies which will produce returns and other lines or policies which will produce additionals, it is proper to hold the net return as the reserve, since only one insured is involved and actual settlements with the insured are on a combined basis, not line by line or policy by policy. If, however, one insured has a return coming while another insured will be billed for additional premium, the reserve held should be for the returns only. Under the returns only reserving approach, it is possible to develop negative reserves for a line of business but not a negative reserve for the total of all lines.

Our company analyzes each retrospective adjustment separating the premium into amounts received for commission, taxes, claim expense, other expenses, profit, insurance charge, excess loss premium and losses. The punch cards which are prepared as part of this analysis contain the standard premium and the retro premium for each risk. Exhibit II shows the data obtained by grouping all policies for one insured together and sorting all risks into "return" and "additional" groups. Risks which had

EXHIBIT II

RETROSPECTIVELY RATED BUSINESS OF THE AETNA CASUALTY & SURETY COMPANY

Policy Years 1958-1961 All Lines of Business Combined

(000 omitted from dollars)

	Risks Producing Additional Premiums		Risks Producing Return Premiums		Deviations		Ratio	
PY	Standard Premium	Retro Premium	Standard Premium	Retro Premium	(4)−(5) Returns	(6)+(2)−(3) Net	$\frac{(7)}{(2)+(4)}$	(6)÷(7)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			One Year Term Policies—1st Adjustments				Y	X
58	5,953	7,113	18,016	13,169	4,847	3,687	.154	1.315
59	9,345	11,024	16,777	12,724	4,053	2,374	.091	1.707
60	7,449	9,099	20,128	14,771	5,357	3,707	.134	1.445
61	7,699	9,260	23,054	17,273	5,781	4,220	.137	1.370
			Three Year Term Policies—Adjustments of 1st Year Only					
58	1,430	1,688	4,901	3,824	1,077	819	.129	1.315
59	1,689	2,093	3,703	2,856	847	443	.082	1.910
60	1,593	1,843	4,134	3,237	897	647	.113	1.386
61	3,179	3,618	6,168	4,257	1,911	1,472	.157	1.298

standard premium equal to the retrospective premium, i.e., risks producing no deviation premium, were considered to be "return" risks.

Fitting a least squares line to the data in Exhibit II we obtain the following equation:

$$Y = .286 - .110\,X$$

where Y represents the ratio of the net deviations to earned standard premium and X is the multiplier which converts net deviations to returns only.

This relationship may be used to convert a net reserve to a reserve for returns only as illustrated in the following example:

Earned standard premium for all lines and all policy years for which reserves are held	=	$100,000,000
Net retro reserves	=	$ 7,000,000
Deviations paid to date	=	$ 3,500,000

Then $Y = .105$ and $X = 1.645$

The net retro reserve would be $7,000,000 and the amount required to convert to a returns only reserve would be $4,515,000.

ANNUAL STATEMENT TREATMENT OF THE ADDITIONAL RETRO RESERVE

The additional retro reserve or the reserve correction amount can be added to Page 3 of the Annual Statement of any state requiring a "returns only" reserve as a write-in item. It is preferable to keep the Page 6 unearned premium reserve at its proper net amount so that underwriting results will not be distorted.

SOME CONCLUDING OBSERVATIONS

The methods described here used total losses on retrospectively rated policies. To prevent large losses, which will enter adjustment calculations only at reduced values, from distorting the experience, the system could be modified to remove losses above a certain size. This refinement is of more value in liability lines.

Premiums and losses could be restricted to states and limits which are retrospectively rated rather than being policy totals. Since accounting data were used in the calculations described here, refinements could not be introduced easily.

More important, perhaps, than refining data is the comparison, for reasonableness, of reserve indications to reserves of past years at a similar

age. This comparison requires knowledge of the company's current underwriting results.

Any formula reserving method requires a constant effort to keep factors updated. The formula should not be permitted to operate for long periods of time without frequent critical reviews and, of course, a better formula or method should always be sought.

It should be borne in mind by readers that the formulas shown in this paper are not appropriate for use by any company other than the one supplying the data underlying them. Caution should be exercised in using the methods exactly as described here; individual company conditions may dictate modifications to the methods.