Testing the Reasonableness of Loss Reserves:
Reserve Ratios

By

ABSTRACT

This paper introduces the idea of using "reserve ratios" as tools for testing the reasonableness of loss reserves. The reserve ratios introduced in this paper are the ratios of IBNR to premium, IBNR to reported loss, IBNR to paid loss, total reserve to premium, and total reserve to paid loss. These reserve ratios are shown to have relevance not just by accident year within a line of business, but on a composite basis: across accident years, across lines of business, across companies, and across industry groups. The idea is demonstrated using a database of reinsurance company reserves over a test period spanning accident years 1980-1998 as well as summaries of insurance industry reserves for the period spanning accident years 1991-2000. A general blueprint for using these ratios is also presented along with a series of observations to provide additional perspective for the use of this tool.

INTRODUCTION

The *Statement of Principles Regarding Property and Casualty Loss and Loss Adjustment Expense Reserves* as well as the actuarial standards of practice call on the actuary to test the reasonableness of loss[1] reserve estimates.[2] However, a search of the casualty actuarial literature reveals no techniques for testing the reasonableness of loss reserves beyond the loss ratio test (ultimate losses divided by earned premiums) and frequency/severity tests whenever such data are available.

In the course of searching for tests of reasonableness for a particular set of reinsurance loss reserve estimates, a remarkably stable pattern of IBNR-to-premium ratios was observed for the industry. The stability of this reserve ratio led to exploring other constructions of reserve ratios. Five[3] different reserve ratio constructions showed enough consistency[4] to suggest the possibility that they be made a part of the casualty actuarial literature so that

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[1] Whenever the term "loss" is used it is intended to include both "loss" and associated "loss adjustment expenses."
[2] The CAS *2002 Yearbook*, p. 319, lines 315-316.
[3] Five ratios represent the universe of ratios that could be constructed using: either IBNR or total reserves in the numerator and either premiums, reported losses, or paid losses in the denominator. Note that the ratio of total reserves to reported losses is excluded from the set of six ratios possible as it is a transformation of the ratio of IBNR to paid losses.
[4] "Consistency" as used in this paper simply means a discernible pattern of behavior among the observed ratios over time. Several examples of such consistency are demonstrated in this paper.

the inventory of tests of reasonableness of loss reserves may begin to be expanded.

At this point of the discussion it is useful to make the distinction between the "normal" reserve ratios to which actuaries are accustomed and the reserve ratios proposed in this paper. Reserve ratios are widely used by actuaries in the **determination** of loss reserve estimates, and those are commonly known as "loss development factors." A cumulative loss development factor, when reduced by 1.00, represents the ratio of IBNR to reported (or paid) losses. It should also be noted that such ratios are nearly always used within a (sub)line of business, by accident year (or other period), and within company (or insurer group). In contrast, the proposed reserve ratios (a) are intended for use in **testing** a loss reserve estimate after it has been established (or just before it is adopted – testing it for potential reasonableness) and (b) have application on a composite basis, combining accident years, and/or lines of business, and/or different companies.

THE BASIC IDEA

One of the questions that arises immediately when one attempts to use reserve ratios to test the reasonableness

of loss reserve estimates is the source and identity of various benchmarks one could use for such testing. The basic idea advanced in this paper is that compilations of histories of reserve ratios are likely to reveal stable patterns that can be useful in testing loss reserves for reasonableness. This process is described, illustrated, and discussed in the remainder of this paper.

DATA SOURCES

The main data source for this paper is a database containing detailed historical data drawn from Schedule P's of published Annual Statements for all U.S. reinsurers who reported their data to A.M. Best Company.[5] A secondary source of data is the 2001 edition of Best's Aggregates & Averages. This source contains accident year data that spans the 1991-2000 experience period.

RESERVE RATIOS

The construction of five different reserve ratios is illustrated in the following table for the reinsurance

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[5] The database consisted of all companies whose main business is reinsurance. The database was constructed by A. M. Best Company as a special compilation of all reinsurers.

industry in total, for all lines of business combined, as of December 31, 1995.

First, the raw data used to calculate the ratios are shown in Table A:

TABLE A
Reinsurance Industry
All Lines of Business Combined
As of 12/31/1995
(In $ Millions)

Accident Year	Net Earned Premium	Net Paid Loss	Net Case Reserve	Net IBNR Reserve
(1)	(2)	(3)	(4)	(5)
1995	17,748	2,521	2,593	7,549
1994	16,368	5,490	2,691	4,386
1993	14,630	6,029	1,846	2,975
1992	12,777	8,384	1,312	1,952
1991	12,214	6,679	964	1,648
1990	11,130	6,094	925	1,360
1989	10,210	6,131	596	751
1988	10,650	5,233	603	665
1987	11,860	5,544	437	592
1986	11,025	5,647	464	475
Totals	128,613	57,751	12,430	22,355

The reserve ratios are now constructed using the natural definition of each of the ratios (column references refer to the columns in Table A):

IBNR to Premium: This is the ratio of the net IBNR reserve to the net earned premium [the ratio of Column (5) to Column (2).]

IBNR to Paid Loss: This is the ratio of the net IBNR reserve to the net paid loss [the ratio of Column (5) to the Column (3).]

IBNR to Reported Loss: This is the ratio of the net IBNR reserve to the net reported loss (paid plus case reserve) [the ratio of column (5) to the sum of Columns (3) & (4).]

Total Reserve to premium: This is the ratio of the net total reserve (IBNR plus case reserve) to the net earned premium (the ratio of the sum of Columns (4) & (5) to Column (2).]

Total Reserve to Paid Loss: This is the ratio of the net total reserve (IBNR plus case reserve) to the net paid loss [the ratio of the sum of Columns (4) & (5) to Column (3).] These ratios are shown in Table B using the raw data from Table A:

TABLE B
Reserve Ratios
Reinsurance Industry
All Lines of Business Combined
As of 12/31/1995
(All Figures Are Percentages)

Accident	IBNR To	IBNR To Reported	IBNR To	Total Reserve To	Total Reserve To

Year	Premium	Loss	Paid Loss	Premium	Paid Loss
1995	43	148	299	57	402
1994	27	54	80	43	129
1993	20	38	49	33	80
1992	15	20	23	26	39
1991	13	22	25	21	39
1990	12	19	22	21	38
1989	7	11	12	13	22
1988	6	11	13	12	24
1987	5	10	11	9	19
1986	4	8	8	9	17
Totals	**17**	**32**	**39**	**27**	**60**

The fact that each of the five ratios steadily declines as the accident year ages and develops is not surprising as each ratio must ultimately reach zero when the last claim is closed.

However, when these ratios are calculated for each of the years in the reinsurance database used in this study, and the results for each of the years in the sample universe are aligned so that comparable values are set side-by-side, some interesting, and at times remarkable, patterns emerge. The concept is illustrated in Table C for the ratio of IBNR to premiums.

TABLE C
Reinsurance Industry
All Lines of Business Combined
Ratio of IBNR to Premium by Accident Year

Acc	Y	r	s		o	f		D	e	V	Composite
Year	1	2	3	4	5	6	7	8	9	10	Ratios

	1	2	3	4	5	6	7	8	9	10		
1980										**3**		**81**
1981									3	**3**		**18**
1982								**6**	5	5		**18**
1983							**7**	7	7	6		**17**
1984						**10**	9	8	8	7		**16**
1985					**11**	10	8	7	6	6		**17**
1986				**14**	11	8	7	6	5	**4**		**17**
1987			**19**	14	11	9	7	6	**5**	4		**18**
1988		**29**	21	16	11	9	8	**6**	5	4		**17**
1989	**42**	27	21	15	11	9	**7**	6	5	**4**		**15**
1990	43	30	22	17	15	**12**	10	8	**6**			
1991	43	28	19	16	**13**	12	9	**7**				
1992	41	25	18	**15**	13	10	**8**					
1993	40	27	**20**	16	10	**8**						
1994	41	**27**	20	13	**9**							
1995	**43**	28	20	**14**								
1996	41	25	**17**									
1997	42	**23**										
1998	**40**											
Ave	42	27	20	15	12	10	8	7	6	5		17

The construction of this table follows directly from calculations similar to those found in Table B. For example the values for calendar year 1995 in Table B are inserted in the appropriate cells in Table C. More specifically, for accident year 1995 at the end of 1 year of development, the ratio is 43% (See Table B for the derivation), for accident year 1994 at the end of 2 years of development, the ratio is 27% (See Table B for derivation), and so on up a northeasterly direction along the diagonal until the last value for 1995 is shown: for accident year 1986 at the end of 10 years of development – where the ratio is 4% (See Table B for derivation.) Finally, the composite ratio at 17%, is also drawn from Table B, where it is the sum of the reserves for all

accident years divided by the sum of the earned premiums for all the accident years – as derived in Table B.

The consistency observed in Table C is rather remarkable. The composite ratios range from 15% to 18% with a tight distribution around 17%. And the same type of observation can be made about the distribution of ratios at the end of each year of development.

What makes this result particularly interesting is the fact that these patterns "automatically" subsume a vast assortment of differing operational elements implicitly imbedded in the raw data, including but not limited to:

A. Differences in reserving practices from company to company.

B. Changes in coverage limits written from year to year and differences in coverage limits written among companies.

C. Changes in coverage definitions.

D. Differences due to the varying utilization of special coverage features such as the index clause and aggregate deductibles.

E. Changes due to the introduction of new coverages.

F. Variations in mix of business over time.

G. Differences in policy with respect to setting

    additional case reserves.

H. Differences in marketing methods.

I. Differences in underwriting policies.

J. Differences in claim adjustment practices.

K. Differences in pricing methodologies and philosophies.

L. Different business cycles.

This list merely illustrates the kinds of things that are,

in effect, "netted" completely in Table C. Of course, the

list of such factors is nearly endless and only serves to

underscore the remarkable consistency of these patterns.

The tables for the other four reserve ratios show similar

patterns and all five tables are included in Appendix A.

RESERVE RATIOS BY COMPANY

When similar tables are constructed for individual

reinsurers, the patterns of consistency persist, albeit

often at a slightly different level. This idea is

illustrated in Tables D and E for the IBNR to premium

ratio. Table D represents the corresponding ratios for a

large reinsurer while Table E represents the corresponding

ratios for a mid-sized reinsurer.

TABLE D
A Large Reinsurance Company
All Lines of Business Combined
Ratio of IBNR to Premium by Accident Year

Acc Year	Y 1	r 2	s 3	4	o 5	f 6	7	D 8	e 9	v 10	Composite Ratios
1980										2	18
1981									2	2	18
1982								3	2	2	14
1983							2	2	2	2	12
1984						3	3	2	2	5	14
1985					2	5	2	2	4	4	15
1986				16	14	9	5	3	3	1	16
1987			15	13	8	5	4	3	1	1	17
1988		35	22	14	7	6	5	3	2	3	17
1989	50	29	15	8	7	5	3	2	6	6	15
1990	49	22	15	11	8	6	2	5	4		
1991	42	20	14	10	6	5	6	4			
1992	41	20	14	13	11	8	4				
1993	45	28	21	15	11	7					
1994	48	31	22	14	8						
1995	48	30	21	14							
1996	45	26	15								
1997	47	25									
1998	44										
Ave	46	27	17	13	8	6	4	3	3	3	16

Table D reveals that the long-term historical composite average for this company is very much in line with the industry levels (16% for the company vs. 17% for the industry). Also, Table D demonstrates the expected result that, although consistent with industry levels over a long period of time, the distributions by accident year are not as compact as the distributions for the industry in total. The tables that show the corresponding results for all of the five reserve ratios for this company are produced in Appendix B. The same observations made in this text extend almost verbatim to the other reserve ratios.

TABLE E
A Mid-Sized Reinsurance Company
All Lines of Business Combined
Ratio of IBNR to Premium by Accident Year

Acc Year	Y 1	r 2	s 3	4	o 5	f 6	7	D 8	e 9	v 10	Composite Ratios
1980										1	22
1981									1	0	22
1982								3	3	2	23
1983							7	6	6	7	22
1984						6	5	5	7	6	21
1985					7	6	8	5	5	3	20
1986				20	16	15	15	12	10	8	19
1987			30	23	24	22	19	17	14	3	21
1988		39	32	27	23	22	21	20	4	4	20
1989	51	36	28	24	22	18	18	6	6	4	15
1990	47	31	23	20	17	16	9	8	5		
1991	45	31	23	18	17	12	9	6			
1992	43	28	17	13	17	13	8				
1993	40	20	14	20	15	9					
1994	49	34	26	16	10						
1995	38	40	27	16							
1996	59	46	31								
1997	48	29									
1998	50										
Ave	47	33	25	20	17	14	12	9	6	4	21

In the case of the mid-sized reinsurer, the patterns are again quite regular, however, overall, this company's composite historical reserve ratio is at 21% vs 17% for the industry. One must hasten to add that one cannot simply conclude that, by noting just this 21% vs. 17% comparison, this is indicative of a greater degree of adequacy than the industry. Such a conclusion requires significant additional independent confirmation.

One may conclude, however, that the distribution that produces the 21% average is so compact as to be suggestive

of a consistent internal reserving policy.[6] The tables that

show the corresponding results for five reserve ratios for

this company are produced in Appendix C. The same

observations made in this text extend almost word for word

to the other reserve ratios.

The research underlying this paper included a review of the

reserve ratio patterns for every company in the database

for which experience for the entire test period was

available and, with rare exception, every company did

develop a series of reserve ratio patterns that exhibited

regularity. Although the degree of regularity varies by

company, for the great majority of cases the regularity

that is exhibited is sufficient to render the grid of

historical reserve ratios a useful tool for assessing the

reasonableness of loss reserves.

RESERVE RATIOS BY LINE OF BUSINESS

When similar tables are produced by line of business, the

regularity of reserve ratio patterns persists but, as can

be expected, the patterns do not exhibit the same degree of

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[6] The 15% composite ratio for 1998 appears to be an outlier when compared
with the historical pattern. All other things being equal, this

compactness of distribution. The line of business

phenomenon is illustrated for "Other Liability" in Tables F

and G for the IBNR to premium ratio for the reinsurance

industry in total and for the same large company used

above, respectively. In Table F, as one might expect, due

to the nature of the coverage, the progression of the

reserve ratios towards zero is slower than for all lines

combined. The patterns are regular in this case as well,

although the distributions are not nearly as compact as for

all lines of business combined.[7] Part of this may be due to

the discretion that is often exercised in classifying

business by Annual Statement line of business category when

more than one line of business may apply. There are no

hard and fast rules on the application of business to

Annual Statement line of business classification whenever

the classification is not unique. Nevertheless, the

consistency of reserve ratio patterns is, once again,

noteworthy.

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observation suggests the need for further exploration and
rationalization of the derivation of the 1998 reserve level.
[7] Of course many possibilities can give rise to distributions that are
not as compact – and identifying and articulating those is beyond the
scope of this paper. However, we should note that exposure and
reserving for latent liabilities could be a significant factor in
creating distributions that are not as compact as noted for other
aggregates of data. Another factor could be the effect of judicial
decisions that affect open claims in such lines as Workers
Compensation.

TABLE F
Reinsurance Industry
Other Liability[8]
Ratio of IBNR to Premium by Accident Year

Acc Year	Yrs 1	2	3	4	5	6	7	8	9	10	Composite Ratios
1980										10	**33**
1981									**11**	12	**31**
1982								**15**	15	16	**29**
1983							**16**	19	20	22	**27**
1984						**20**	23	25	27	25	**25**
1985					**18**	17	16	17	15	13	**23**
1986				**31**	23	18	15	13	10	9	**23**
1987			**42**	34	26	20	18	16	13	10	**24**
1988		**46**	37	25	20	18	16	14	12	10	**25**
1989	**56**	45	33	25	22	17	13	11	10	**8**	**23**
1990	57	45	33	26	22	16	14	11	**8**		
1991	62	43	33	25	17	14	10	**8**			
1992	58	41	30	19	12	12	**9**				
1993	58	44	32	23	17	**14**					
1994	55	42	34	22	**19**						
1995	59	46	32	**24**							
1996	59	40	**25**								
1997	65	**41**									
1998	55										
Ave	58	43	33	25	20	17	15	15	14	14	26

The set of five tables that extend this analysis to the five reserve ratios is shown in Appendix D.

TABLE G
A Large Reinsurance Company
Other Liability
Ratio of IBNR to Premium by Accident Year

Acc Year	Yrs 1	2	3	4	5	6	7	8	9	10	Composite Ratios
1980										2	**18**
1981									**2**	2	**18**
1982								**3**	2	2	**14**

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[8] For this line of business, data for accident years 1989-1992 include all other liability business whereas accident years 1993-1998 include only the "Other Liability – Occurrence Coverage". This is due to the change in Schedule P reporting requirements that occurred first for the 1992 Annual Statement.

Year												Comp
1983							**2**	2	2	2		12
1984						**3**	3	2	2	5		14
1985					**2**	5	2	2	4	4		15
1986				**16**	14	9	5	3	3	1		16
1987			**15**	13	8	5	4	3	1	1		17
1988		**35**	22	14	7	6	5	3	2	3		17
1989	50	29	15	8	7	5	3	2	6	**3**		21
1990	49	22	15	11	8	6	2	5	**1**			
1991	42	20	14	10	6	5	6	**2**				
1992	41	20	14	13	11	8	**4**					
1993	45	28	21	15	11	**7**						
1994	48	31	22	14	**15**							
1995	48	30	21	**35**								
1996	45	26	**26**									
1997	47	**35**										
1998	50											
Ave	47	28	19	15	9	6	4	3	3	3		16

For the large reinsurance company, the same observations
may be made: the reserve ratio patterns are regular,
although the distributions are not as compact as the
industry distributions. However, the composite ratios once
again show a remarkable compactness. The composite all-year
reserve ratio for this company is 16% while the industry
counterpart is 26%. This is the opposite of the phenomenon
that was observed earlier for the mid-sized reinsurer on an
all lines basis (where the company ratios were higher than
the industry ratios). In this case the company ratios are
lower than the industry counterpart. Once again, this
observation, when considered alone, cannot be used to
conclude that the company is under-reserved for the other
liability line of business. For additional perspective, we
also note that this same company showed, on an overall all

lines combined basis, reserve ratios that are quite
comparable to the industry counterparts.

The set of five tables that extend this analysis to all
five reserve ratios is shown in Appendix E.

Finally, three demonstrations drawn from Best's Aggregates
& Averages will round out the illustration of patterns that
can emerge from the compilation of historical reserve
ratios.

First, in Table H, we show the ratio of IBNR to premiums
for all lines of business combined for all companies
combined. It is clear that the pattern in Table H reflects
a gradual reduction in the IBNR to premium ratio. The
consistency is present at all valuation dates.

TABLE H[9]
Property & Casualty Insurance Industry
All Lines of Business Combined
Ratio of IBNR to Premium by Accident Year

Acc	Y	r	s		o	f		D	e	v
Year	1	2	3	4	5	6	7	8	9	10
1991	26.2	14.0	8.9	6.0	4.3	3.2	2.4	1.9	1.5	1.1

[9] This table is truncated because it was not possible to construct the
full parallelogram of ratios on a fully consistent basis.

	1	2	3	4	5	6	7	8	9	10
1992	26.6	14.2	8.9	5.8	4.0	2.9	2.2	1.6	1.1	
1993	25.1	13.9	9.1	5.7	3.7	2.8	1.9	1.3		
1994	24.6	13.3	8.1	4.9	3.6	2.5	1.8			
1995	23.3	12.4	7.6	4.7	3.3	2.2				
1996	22.2	11.4	6.7	3.8	2.4					
1997	20.9	10.4	5.9	3.2						
1998	19.6	9.2	5.2							
1999	19.5	8.9								
2000	19.7									

Tables I and J extend the construction of Table H to two lines of business: workers compensation in Table I and commercial auto liability in Table J. In both tables it is again readily noticeable that the ratios of IBNR to premiums yield another indication of consistent patterns:

TABLE I
Property & Casualty Insurance Industry
Workers Compensation
Ratio of IBNR to Premium by Accident Year

Acc	Y	r	s		o	f		D	e	v
Year	1	2	3	4	5	6	7	8	9	10
1991	36.1	20.1	13.0	9.2	7.1	5.9	5.0	4.1	3.3	2.4
1992	39.0	23.0	15.3	9.8	7.4	6.1	4.9	4.0	3.1	
1993	38.3	24.1	17.4	10.6	8.4	5.8	4.2	3.2		
1994	37.2	23.3	16.0	10.1	6.9	5.2	3.8			
1995	35.1	21.2	14.7	8.9	6.6	5.0				
1996	32.4	18.8	12.8	8.0	5.6					
1997	30.9	16.7	10.7	7.3						
1998	30.3	14.5	9.6							
1999	29.4	14.0								
2000	30.3									

TABLE J
Property & Casualty Insurance Industry
Commercial Auto Liability
Ratio of IBNR to Premium by Accident Year

Acc	Y	r	s		o	f		D	e	v
Year	1	2	3	4	5	6	7	8	9	10
1991	37.7	19.3	10.5	6.1	3.5	2.3	1.3	1.0	0.5	0.2

1992	35.7	18.3	10.4	6.1	3.5	2.0	1.2	0.7	0.2
1993	33.6	16.4	9.5	5.2	2.8	1.6	0.9	0.5	
1994	31.6	16.2	8.5	4.3	2.6	1.5	0.8		
1995	31.4	15.3	7.5	3.6	2.2	1.3			
1996	30.3	14.2	7.4	3.3	1.8				
1997	29.8	14.5	6.4	3.2					
1998	29.8	13.3	6.5						
1999	28.0	13.0							
2000	28.8								

USING RESERVE RATIOS TO TEST REASONABLENESS

Given that these reserve ratio benchmarks exist, how does one go about using them?

As previously illustrated, reserve ratio benchmarks may be calculated by (a) accident year at various points of development and by calendar year, (b) by line of business and on all lines basis, and (c) by individual company or on an industry-wide basis. Thus in testing the reasonableness of loss reserve estimates, one may be in a position to test any combination of these year/line/company parameters.

For purposes of this discussion, the focus will be on testing an individual company's proposed loss reserve estimates for a single line of business for all years combined as of a point in time. More specifically, let us assume that an actuary has calculated the loss reserve estimates by line of business by accident year and is

interested in using the reserve ratios as a way to test the
reasonableness of the proposed reserve estimates as of
December 31, 1999.

The first step is to compile the historical reserve ratio
grids for the company by accident year, by line of
business, and for all lines of business combined for the
accident year reserve pieces that make up the calendar year
reserve estimate as of December 31, 1999. These
calculations are identical to the calculations used to
construct the ratios shown in the Appendices. In addition,
the actuary may construct similar reserve ratio grids for
the total industry, reinsurance industry or for some
portions of it that the actuary deems to be similarly
situated to the particular company whose reserves are under
review. From this point, the testing branches out in two
directions:

A. Internal Tests. These are the tests that compare the
   company reserve ratio vectors for the specific line of
   business as of December 31, 1999 to the corresponding
   historical company reserve ratio vectors for the same
   line of business as of December 31, 1998 and before, as
   far back as one can identify.

B. External Tests. These are the tests that compare the

company reserve ratio vectors for the line of business

as of December 31, 1999 to the corresponding industry

(or portion of the industry) historical reserve ratio

vectors for the same line of business as of December 31,

1998 and before, as far back as one can identify.

For each of the two paths, the possible categories of

outcomes are identical and the analyses are parallel. The

categories of outcomes are listed below and the general

disposition of each is noted:

A. The 1999 reserve ratios (of various types) are close to

the historical benchmarks. In this case one may draw

the preliminary conclusion that the level of adequacy

has not changed from prior years. Note that even this

result does not suggest that this is the end of the

test. The actuary needs to review the key operational

changes that occurred in 1999 (and possibly 1998) for

the subject line of business that might cause the 1999

reserve vectors to differ from historical patterns. If

there are no such changes, the test can be concluded at

this point. If there are such changes and the reserve

vectors do not reflect any corresponding differences, then the actuary is obliged to examine the reserve methodologies and assumptions to make sure that nothing material was overlooked. The results of the test can thus be confirmed or the reserve estimates would have to be adjusted to recognize the changes.

B. The 1999 reserve ratios (of various types) for the line of business are at significant variance to the historical benchmarks. The first level of response is to try to pinpoint the source of such variance by examining the reserve ratio vectors for the line of business at the individual accident year level, at various points of development, in order to locate the source (or sources) of the variance. At this point an examination of the reserve calculations leading to the unusual reserve ratio vectors is called for. The result would be to either rationalize and confirm the original proposed reserve estimate or make such changes as may be called for after examination of the facts as well as operational changes that might cause such changes to occur.

C.   The 1999 reserve ratios (of various types) are mixed;

     some are consistent with historical benchmarks and some

     are not. In this case, once the source (or sources) of

     differences has (have) been pinpointed, the analyses

     described in the two paragraphs immediately preceding

     apply separately to the parts that are consistent with

     historical results and to the parts that are not

     consistent with historical results.

In all these cases, it should be noted that in comparing

the 1999 reserve ratio vectors to the historical reserve

ratio vectors, the actuary probably should give some slight

preference to the reserve ratio vectors generated by the

more recent years, such as those observed in 1998, 1997 and

1996.

CONCLUDING REMARKS

A number of observations can be made to round out the

presentation and give additional perspective on the

proposed benchmarks and associated methodologies:

A. It should be pointed out that although it is clearly suggested that reserve ratios can be a useful tool in testing the reasonableness of loss reserves, there is absolutely no suggestion whatsoever that reserve ratios can be used as the basis for setting loss reserves.

B. Although the reserve ratios discussed in this paper may be easily constructed for a single company, it is difficult and may be expensive to obtain the raw data to construct these ratios for the entire industry or some subgroup of the industry.

C. It is axiomatic that the historical reserve ratio patterns will change over time – whether one is considering an individual company's pattern or its industry counterparts. However, it should be recognized that such changes should emerge slowly. Sharp and sudden changes should serve as flags for further analysis and examination. Thus when comparing proposed reserve ratios to historical reserve ratios, absent an event of significant import, one can reasonably rely on historical patterns for guidance in

the assessment of the reasonableness of loss reserve estimates.

D. The patterns that are recognized in this paper are empirically based. In other words, without a theoretical proof, the patterns that have emerged through the analyses performed herein are simply recognized to exist and persist. These empirical patterns can serve a useful purpose in shedding some light on the issue of the reasonableness of loss reserve estimates.

E. It should be acknowledged that no ratio should be used alone. In other words, all the available reserve ratios should be tested and a conclusion reached based on the analysis of all the available reserve ratios. To put it in the converse, using a single reserve ratio with no other confirmation easily can lead to erroneous conclusions with respect to the reasonableness of reserve estimates.

F. The key idea underlying the use of reserve ratios for testing the reasonableness of loss reserves is to spot significant variances and to either explain the

variances or change the methodology and assumptions
that ultimately led to the observed variance.

G. In producing the results presented in this paper, no
reserve ratios were available to construct reserve
benchmarks that went beyond ten years of development.
Even though this condition is due to the limitations
inherent to Schedule P reporting requirements, it is
possible to test the reasonableness of accident years
beyond ten years of development by simply constructing
a monotonically decreasing sequence of reserve ratios
that approaches zero. Judgment is required in making
this construction in terms of the number of years of
development to ultimate and in terms of the rate of
decrease that can be imputed to the particular reserve
ratio vector that is under review. Or, it may be
possible to construct reserve ratios that go beyond
ten years of Schedule P development using the
company's internal databases. Thus one can conduct
some simple tests of reasonableness of the reserve
estimates of the older years.

H. One of the problems that face actuaries is the
occasional need to render an opinion on the

reasonableness of loss reserves that were set some time ago. It is clearly unreasonable to re-estimate the reserves a number of years after they were originally set. Although it is technically possible to calculate such reserves, such exercise cannot be used to pass meaningful judgment on the reasonableness of the reserves at the time they were originally set. However, using the reserve ratios that existed **at the time** the original reserves were set can be a useful tool in testing the reasonableness of loss reserves that were set at the time they were set. In conjunction with reviewing the reasonableness of assumptions and appropriateness of methodology used in deriving the reserve estimate, reserve ratios can provide a useful addition to the process of assessing the condition of loss reserve estimates set some years back.

I. It should be noted that these reserve ratios may be of value as yet another view of the condition of loss reserves in connection with mergers & acquisitions work.

J. Finally, it should be noted that even when very stable patterns (either flat or increasing or decreasing ratios) are observed, it should be clear to the reader that to assume such patterns will persist in the future goes far beyond what is suggested in this paper. In fact, it is strongly suggested that anyone who desires to use reserve ratios as a means of testing reasonableness should take great care to update the data at least annually lest stale patterns cause erroneous conclusions to creep into the analysis.

It is the author's hope that utilizing reserve ratio benchmarks such as described in this paper can provide a few additional guideposts along the difficult path of setting loss reserves that are reasonable and that are neither redundant nor inadequate.

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