

Getting the Numbers Right

Investors and regulators now can estimate the impact of future reserve variability on insurers' earnings.

by C. K. Stan Khury and Charles A. Bryan

Loss reserves, generally the largest liability on insurers' balance sheets, are the estimated cost of settling unpaid claim liabilities. Under generally accepted accounting principles and statutory accounting principles, changes in reserve estimates are recognized in the year they occur, not the year policies were issued. Adjustments can turn a profitable year into a loss or even destroy an insurer's entire capital base.

An objective process exists that can estimate the variability inherent in loss reserves. This process can identify a benchmark for what company history indicates the reserve should be. It also identifies where the carried reserves stand in relation to all possible estimates that can be calculated from historical data using the loss development method.

This process has been applied to published historical data for 11 publicly traded insurers that write substantial volumes of liability risks, allowing investors and regulators to estimate the impact of potential future reserve variability on their reported losses and, therefore, on earnings and policyholders surplus.

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Publicly traded insurers must comply with both the National Association of Insurance Commissioners and the Securities and Exchange Commission disclosure rules. The NAIC disclosures are of little value to investors because the most important disclosure—the comparison between the carried reserves and the range of estimates developed by the actuary—is proprietary and not available to the public. The SEC calls for significant public disclosures on reserve variability, including sensitivity of estimates to reasonable alternative assumptions and the probability that the alternative estimates, rather than the selected estimates, will occur. Unfortunately, the probability analysis contemplated by the SEC is voluntary and insurers generally have not provided any meaningful analyses in their 10-K filings.

Reasonable Benchmark

Although there is no perfect process that will satisfy both NAIC and SEC requirements as well as stock analysts' requirements, we describe a process that establishes a benchmark loss reserve in those situations where the company has sufficient history to apply loss development methods. This benchmark provides a reasonable estimation of the loss reserve level, including a range of reserves and the probability the reserve level will be adequate to pay all the claims it is intended to cover.

► **The Situation:** Adjusting reserve estimates can move profits into the loss column.

► **The Significance:** Measuring loss reserve variability is important to regulators and financial analysts who assess the quality of a company's earnings.

► **What Happened:** An algorithm was developed that can determine the probability that a carried reserve will be adequate to satisfy existing liabilities.

The loss development method applies historically observed patterns of loss development, called loss development factors, to known claims to project ultimate losses for a category of business. An analyst applying the loss development method selects individual LDFs for each line of business and development period, along with a tail factor that recognizes additional development may occur in periods when no loss development history exists.

Since there are no prescribed actuarial rules for selecting LDFs, the analyst usually examines the historical values that have been observed for each period and selects a period-to-period LDF that most likely will represent future development. The period-to-period LDFs are then accumulated multiplicatively and multiplied by known claims to estimate ultimate losses for each category of business and accident year. The number of LDF combinations that can be selected is staggering. For example,

given 11 accident years, 11 valuations, and a single tail factor, an actuary can identify 6.7 octillion (the equivalent of 6.7 million trillion trillion) possible ultimate loss outcomes. Up until now, this large number of possibilities has precluded consideration of any process that considered all possible outcomes.

The process described in this article solves the problem of calculating so many LDFs by using an approximation algorithm to produce an empirical frequency distribution for all combinations that can be produced by the loss development method. The resulting distribution is equivalent to the distribution produced if it were possible to calculate every single LDF combination for every accident year.

Unlike other models that require assumptions about the distribution of outcomes, this approximation algorithm does not require any assumptions about the shape of the distribution; it is based solely on historical loss development. By determining where a carried reserve falls on the continuum of all possibilities produced by the loss development method, an analyst can calculate the probability the carried reserve will be adequate to satisfy existing liabilities. The relationship between the carried reserve and the mean reserve of the

distribution is illustrated in the “Distribution of Reserve Outcomes” chart for a sample insurer (below).

The area under the curve represents the universe of all the estimates that can be calculated for the hypothetical insurer. The range of reasonable estimates is bounded by the dotted lines; the mean of the distribution is represented by the center vertical line; and the carried reserve is represented by the solid right vertical line. Since the area to the left of the carried reserve line in this case is 77% of the area under the curve, there is a 77% probability the carried reserve will be adequate to cover all liabilities for the hypothetical company as of the evaluation date.

Application to Data

The process was applied to reported loss development data of 11 publicly traded insurance groups using Schedule P data from their 2005 Statutory Annual Statements, as consolidated by the A. M. Best Co. By applying the process to data for the period ending Dec. 31, 2005, we can obtain the type of information sought by the SEC, such as the upper and lower range of variation in the reserves and the probability the carried reserve will be adequate to satisfy existing liabilities.

The use of Schedule P data has advantages and disadvantages. The data are publicly available, reliable and detailed with respect to line of business for the most recent 10 accident years. On the other hand, Schedule P data do not provide details on accident years older than 10 years; are less refined than company data at the line-of-business level; and are net of reinsurance (we selected data from Schedule P, Parts 2, 3, and 4). The amount of reinsurance, both assumed and ceded, can have a significant impact on the variability of loss reserves, and Schedule P does not contain enough data to indicate the full range of variability.

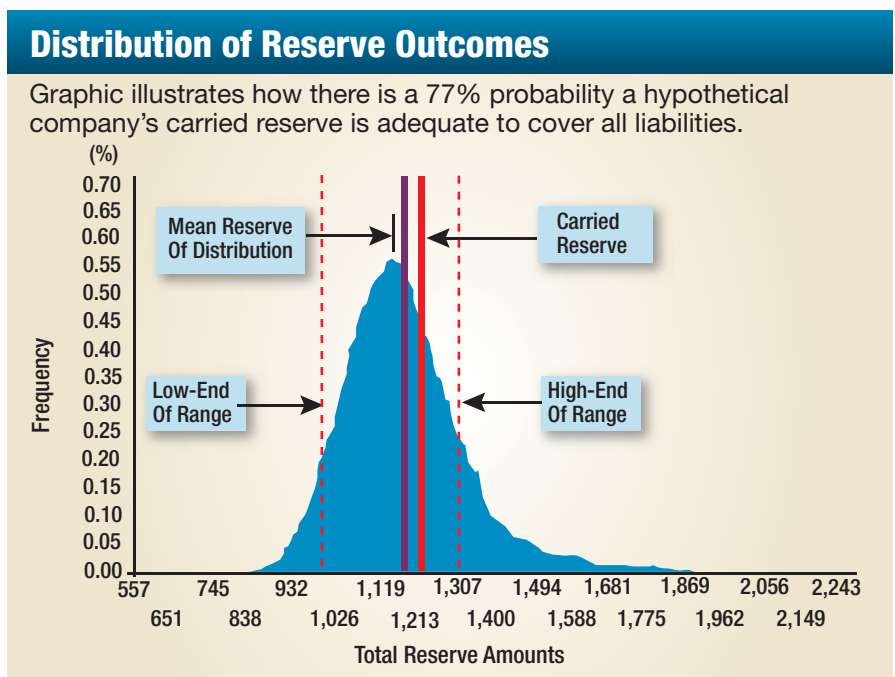
In addition, there are several other limitations:

- The analysis is based solely on historical experience and may not reflect future changes in the business or in the claims settlement environment.
- A composite result for each group is calculated by weighting the probabilities for each line of business by the means of the distributions for the individual lines. Other approaches are possible, such as creating a convolution distribution.
- The analysis relies solely on the most recent 10 accident-year histories. Reserve adjustments for several types of claims are frequently assigned to older years in Schedule P. Asbestos claims, for example, are commonly allocated to accident years in the 1940s, '50s and '60s.

In general, we felt that an analysis based on Schedule P data provided acceptable results. Of course, if internal data can be used that are superior to Schedule P data, then this process should be applied to the superior data.

Analysis Results

We applied the process to Schedule P data for each liability line of business of each insurer group to produce an empirical frequency distribution of all possible outcomes produced by the loss development method. We then compared the carried reserve for each line to the mean of the distribution.



A probability of adequacy for each line of business was calculated for the 1996-2005 accident years combined, by determining the percentage of all possible outcomes that were less than the carried reserve. The lines of business were weighted to arrive at a single percentage for all lines combined. We established a range of reasonableness based on the number of outcomes that fell within one standard deviation from the mean. On average, this selection for the range of reasonableness accounted for 68.4% of all the possible outcomes, with 15.8% of the outcomes below the low-end of the range and 15.8% above the high-end of the range. Table 1 summarizes the results of the analysis.

the higher level of risk associated with the lower probability of adequacy shown in Table 1. As of Dec. 31, 2005, AIG and Berkshire Hathaway reported combined shareholder equity of \$178 billion.

Like other groups in the sample, the composite probability of adequacy figures for AIG and Berkshire Hathaway were derived by the weighting procedures previously described. A line-by-line analysis of the results for the two groups provides additional insight into the broad conclusions that can be drawn from Table 1.

For example, analysis of AIG's line of business probabilities indicates that the three lines of business with the highest probabilities of adequacy

Items to Consider

It is very important to keep certain considerations in mind.

For instance, according to statutory codification, management sets loss reserves at its best estimate by considering a variety of actuarial, financial, economic and legal issues. The reserving process employed by management, including the use of critical accounting estimates, is described in the Management Discussion & Analysis section of their annual reports on SEC form 10-K. While management has the final word on reserves, companies are required to file a Statement of Actuarial Opinion prepared by a qualified actuary, affirming that the reserves meet the requirements of the insurance laws of the domiciliary state, were computed in accordance with accepted reserving standards and make a reasonable provision for unpaid claims.

There are no generally accepted standards for establishing a range of reasonableness for reserve estimates. We used one standard deviation from the mean of the distribution, which captured, on average, 68.4% of the outcomes. Using the standard deviation recognizes the inherent variability of the reserves by line of business. The range of reasonableness produced by the standard deviation is generous—84.2% of the outcomes are below the high end of the range. Other ranges could be selected using different criteria. In their Statements of Actuarial Opinion, actuaries are required to identify the range of reasonableness selected and explain the reasoning behind their choices.

Reinsurance liability was the only line where the carried reserves were below the mean for the 11 groups as a whole. Table 2 shows the total group reserves for each liability line of business; the mean of the distribution for each line; the variance between the mean and the carried reserve; the low end of the range of reasonableness; and the variance between the low end of the range and the carried reserve. The lines of business in the table are arranged in

Table 1

Loss Reserve Variability, Schedule P Liability Lines Of Business for 1996-2005 Accident Years

As of Dec. 31, 2005
(\$ Millions)

Insurance Group	Carried Reserves	% of Total Reserves	Prob. of Adequacy	Range of Reasonableness		
				Low	Mean	High
AIG	35,840	84.4	31.6	33,048	38,367	43,686
Travelers	25,041	86.9	79.4	22,619	23,682	24,749
Berkshire Hathaway	18,906	76.3	33.8	19,980	21,669	23,360
Chubb	12,669	91.4	92.3	9,560	10,570	11,577
CNA	12,427	87.6	57.5	11,159	12,165	13,171
Hartford	10,587	96.0	71.8	8,894	9,337	9,779
W. R. Berkley	5,597	98.6	72.1	4,706	5,187	5,668
Safeco	3,508	90.1	70.0	3,248	3,408	3,569
Cincinnati	2,667	94.8	93.9	1,996	2,134	2,303
Everest Re	2,594	72.4	44.0	2,489	2,953	3,419
Zenith	1,137	89.4	99.9	867	922	977

According to this analysis, most of the groups in Table 1 reserved at conservative levels—the carried reserves were above the mean of the empirical distributions. Only three groups in the sample—American International Group, Berkshire Hathaway and Everest Re—carried reserves below the mean of the distribution. If AIG, Berkshire Hathaway and Everest Re (or any group in the sample, for that matter) provided internal data in more detail than Schedule P captures, we may have a different result. Also, given their substantial financial resources and the size of their capital and surplus accounts, both AIG and Berkshire Hathaway may be able to tolerate

cy are: other liability/occurrence; products liability/claims made; and medical malpractice/claims made, with probabilities of 98%, 82% and 80%, respectively. The three lines of business with the lowest probability of adequacy are: other liability/claims made; reinsurance liability; and workers' compensation, with probabilities of adequacy of 9%, 6% and 2%, respectively. Performing the same analysis for Berkshire Hathaway indicates that almost all lines of business enjoy a high probability of adequacy. Only the group's other liability/occurrence and reinsurance liability lines had low probabilities of adequacy at 10% and 0.1%, respectively.

Table 2
Variability by Line of Business

All groups combined, 1996-2005 accident years.
As of Dec. 31, 2005
(\$ Millions)

Line of Business	Carried Reserve	Mean	Reserve - Mean	Low End	Reserve - Low End
Other Liability (Occ)	26,070	22,036	4,034	20,996	5,074
Workers' Compensation	30,482	28,583	1,899	27,922	2,560
Other Liability (CM)	21,609	20,493	1,116	19,129	2,480
Medical Malpractice (CM)	3,904	2,702	1,202	2,546	1,358
Private Passenger Auto	12,927	12,143	784	11,886	1,041
Commercial Auto	7,823	7,236	587	7,059	764
Commercial Multiperil	12,698	12,485	213	12,200	498
Medical Malpractice (Occ)	1,332	1,078	254	1,025	307
Products Liability (CM)	447	369	78	261	186
Products Liability (Occ)	3,408	3,469	-61	3,340	68
Reinsurance Liability	15,472	21,619	-6,147	20,507	-5,035

relation to all possible outcomes that can be generated from the historical data using the loss development method. If management decides that future reporting and development patterns will differ from past patterns, and makes its estimate accordingly, the algorithm calculates the probability of adequacy for the new estimate using the original pattern, thus quantifying the effect of the decision to depart from historical patterns. Management can select a different reserve, but if it does, then the process shows the magnitude of the difference attributable to management judgment—a feature that effectively requires management to demonstrate the soundness of the decision to depart from historical experience.

Senior managers can use the output produced by this process three ways. Table 3 shows the variance between the carried reserve and the mean of the distribution as a percentage of pretax earnings.

Table 3 illustrates the sensitivity of earnings to the selection of a reserve equal to the mean of the distribution. The upper and lower ends of the range of reasonableness could also be selected as alternative estimates. Table 3 also indicates the approximate size of future additions or reductions to pretax earnings suggested by a comparison of carried reserves to historically indicated reserves. (The results

order of the size of the difference between the reserve and the low end of the range.

The results are not surprising. The reinsurance liability line is primarily an excess-of-loss line, often the most difficult type of loss reserves to estimate. Two of the 11 publicly traded groups, Safeco and Cincinnati, did not report any material reinsurance liability business. Of the remaining nine groups, two (Zenith and W. R. Berkley) had carried reserves above the mean; two (Chubb and Everest Re) had carried reserves below the mean but within the range of reasonableness; and five (AIG, Travelers, Berkshire Hathaway, CNA, and Hartford) had carried reserves below the low end of the range. Most of the variance for reinsurance liability was attributable to Berkshire Hathaway, which accounted for more than 73% of the \$6.1 billion shortfall from the mean and 69% of the \$5 billion shortfall from the low end of the range.

The results may be affected by one of the best insurance markets in decades. Historically, the insurance industry has fluctuated between periods of high rates and profits and periods of low rates and depressed profits. There may be a tendency for management to be particularly conservative in setting its reserves at a higher probability of adequacy in the recent period of high profitability.

Effects on Earnings

Measuring loss reserve variability is important to management, regulatory authorities and financial analysts who assess the quality of a company's reported earnings. Publicly traded insurers have acknowledged the variability issue in SEC filings, but have not sufficiently quantified the range of variability or the probabilities associated with their reserve estimates.

Use of this process allows management to measure reserve variability and calculate the probability that the carried reserve will be adequate. The algorithm produces results that show where the carried reserves stand in

Table 3
Impact on Earnings

The effect of the variability observed in Table 1 on pretax earnings, 1996-2005 accident years.
As of Dec. 31, 2005
(\$ Millions)

Insurance Group	Carried Reserve	Mean of Distribution	Reserve Mean	Pretax Earnings	Difference As % Earnings
AIG	35,840	38,367	-2,527	15,213	-16.60%
Travelers	25,041	23,682	1,359	2,671	50.90%
Berkshire Hathaway	18,906	21,669	-2,763	12,791	-21.60%
Chubb	12,669	10,570	2,099	2,447	85.80%
CNA	10,587	9,337	1,250	2,985	41.90%
Hartford	12,427	12,165	262	162	161.70%
W. R. Berkley	3,508	3,408	100	986	10.10%
Safeco	5,597	5,187	410	771	53.20%
Cincinnati	2,667	2,134	533	-281	-
Everest Re	2,594	2,953	-359	823	-43.60%
Zenith	1,137	922	215	238	90.30%

Property/Casualty

in Table 3 are illustrative only, and subject to the limitations and conditions described earlier.)

A second and related use of the results of this process is to quantify the size of the range of reasonable variability in reserve estimates and compare it to key financial benchmarks, as illustrated in Table 4.

tance of this information in its release on critical accounting estimates, noting the probabilities associated with the ends of the range should be disclosed, if known or available, as part of a sensitivity analysis that demonstrates the effect of alternative assumptions on financial results.

SEC, the process can be used on at least two other fronts—responding to examinations by state insurance regulators on the one hand, and by tax authorities on the other. These agencies have concurrent jurisdiction over the loss-reserving practices of insurers, but have opposing interests.

State regulators are charged with ensuring solvency of insurers for the protection of consumers, and thus are concerned when management appears to be lowering its reserves in favor of higher profits. The Internal Revenue Service, in contrast, is concerned with

Table 4

Range of Variability

Comparing the size of the range of reasonableness to shareholders equity, 1996-2005 accident years.

As of Dec. 31, 2005

(\$ Millions)

Insurance Group	Range of Reasonableness		Size of Shareholders Equity	
	High-End	Low-End	Range	Equity
AIG	43,686	33,048	10,638	86,317
Travelers	24,749	22,619	2,130	22,303
Berkshire Hathaway	23,360	19,980	3,380	91,484
Chubb	11,577	9,560	2,017	12,407
Hartford	9,779	8,894	885	15,325
CNA	13,171	11,159	2,012	8,950
Safeco	3,569	3,248	321	4,125
W. R. Berkley	5,668	4,706	962	2,567
Cincinnati	2,303	1,966	337	6,086
Everest Re	3,419	2,489	930	4,140
Zenith	977	867	110	713

By comparing the size of the range to shareholders equity, investors can assess the degree of risk in their investment that is attributable solely to the potential reserve variability of the insurance group. The range as a proportion of shareholders' equity varies from a low of 4% for Berkshire Hathaway to a high of 37% for W. R. Berkley. Of course, there still is a distinct possibility that ultimate losses will fall outside the range of reasonableness.

A third application is to develop the probabilities of occurrence at the ends of the range of reasonableness. Probabilities of occurrence quantify the likelihood that the ultimate settlement value of a reserve falls outside the range of reasonableness.

The SEC has stressed the impor-

The Bottom Line

The proposed process is not intended to set reserves per se, even though it could be used for that purpose. Reserve decisions are the prerogative of management, which is free to consider a variety of factors in setting reserves.

Absent a material and quantifiable change in risk factors, however, historical data should play a predominant role in the reserve-setting process. Departures from historically indicated reserves should be supported by an analysis that quantifies the effect of specific changes on future loss development. The process provides a framework for performing this type of analysis.

In addition to providing the quantitative disclosures called for by the

An objective process exists that can estimate the variability inherent in loss reserves.

tax avoidance and will closely scrutinize loss reserve levels that appear excessive. The process allows management to respond to these conflicting regulatory interests by documenting the reasonableness of their reserving levels based on historical data.

Future applications of the process may determine whether the generally conservative reserving levels observed as of Dec. 31, 2005, were the result of a consistent approach to reserving or a temporary reaction to one of the best insurance markets in decades. The relationship between insurance cycles and reserve levels has been the subject of much commentary and speculation, but apart from anecdotal evidence, there has been no systematic study of the issue. Future applications of the process will shed additional light on the subject. **BR**

(The authors are members of the Reserve Study Group, a not-for-profit corporation dedicated to the study of loss reserving issues.)