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"A KNOWLEDGE COMMUNITY FOR THE SOCIETY OF ACTUARIES"

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An International Financial Reporting Standards (IFRS) Phase II Discussion Paper Primer

by Mark J. Freedman and Tara J.P. Hansen

US GAAP and IFRS are aligning their concepts, principles and rules. This means U.S. insurance companies will almost certainly be impacted by any accounting changes that take place whether they occur domestically or abroad. The only question is how quickly this will occur.

Recently, the SEC issued for public comment a proposal to accept from foreign private issuers financial statements prepared in accordance with IFRS without any reconciliation to US GAAP. The SEC has also issued a concept release to obtain information as to whether U.S. issuers should have the option to prepare financial statements in accordance with IFRS. In addition, in August 2007, the FASB issued an invitation to comment on the International Accounting Standards Board's (IASB) Phase II Discussion Paper (Discussion Paper), entitled "Preliminary Views on Insurance Contracts," in order to assess whether there is a need for a project on accounting for insurance contracts and whether or not to work with the IASB in a joint project.

The landscape of financial reporting here in the United States is changing rapidly, especially with the issuance of FASB Statements No. 157 and 159. Statement No. 157, *Fair Value Measurements,* applies to all existing pronouncements under GAAP that require (or permit) the use of fair value. It also establishes a framework for measuring fair value in GAAP, clarifies the definition of fair value within that framework, and expands disclosures about the use of fair value measurements. Statement No. 159, "The Fair Value Option for Financial Assets and Financial Liabilities," including an amendment

of Statement No. 115, "Accounting for Certain Investments in Debt and Equity Securities," permits entities to measure certain other items not included within the scope of Statement No. 157 at fair value. The issuance of Statement No. 159 by the FASB is a big step forward in requiring fair value reporting. Insurers looking to adopt Statement No. 159 for their insurance contracts will be faced with the challenge of determining

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What's Inside

the fair value of those insurance contract liabilities and are considering the principles in the Discussion Paper.

Developing an understanding of the current direction of IFRS for insurance products is imperative for U.S. accounting and actuarial practitioners. This IFRS Phase II Discussion Paper Primer has been designed to provide a summary of the key proposals and issues that are facing U.S. insurers as this material evolves into authoritative guidance.

The Discussion Paper, issued by the IASB in May 2007, contains the IASB's preliminary views on the various recognition and measurement components considered in accounting for insurance contracts and identifies issues that are still under consideration. The IASB has invited interested parties to comment on the Discussion Paper by November 16, 2007. This process will ultimately lead to an insurance standard that will replace the current IFRS 4 "Insurance Contracts."

This article summarizes the main proposals in the Discussion Paper, and in particular, emphasizes those issues where the views of the IASB are not uniformly accepted.

Objectives

The Discussion Paper reflects a principles-based approach with additional high-level and prescriptive guidance. Insurance contracts are to be subject to the same general principles as those of other financial service entities. This approach seeks to ensure consistency of financial statements for insurance, asset management and banking companies. The revised platform for insurers should lead to increased comparability of financial statements, better identification of key value drivers, and enhanced share values due to improved transparency.

Measurement Model

The proposed measurement model for insurance liabilities rests on three building blocks:

- Explicit, unbiased, market-consistent, probability-weighted, and current estimates of expected future cash flows;
- Discount rates consistent with prices observable in the market place; and
- Explicit and unbiased estimates of the margin that market participants require for bearing risk (risk margin) and for providing any services (service margin).

The expected future cash flows should be explicit, current and consistent with observable market prices, and exclude entity-specific cash flows. There is a subtle, but important, difference between market-consistent and entity-specific assumptions. Claims assumptions, for example, would presumably be the same for both bases, but expense assumptions, for instance, may not be. This is true because the claims experience relates to the block of business and would be transferred with the block of business upon sale, but any entity-specific expense savings that the current entity enjoys may not be transferred with the block.

Developing an understanding of the current direction of IFRS for insurance products is imperative for U.S. accounting and actuarial practitioners.

The IASB believes that discounting should be applied to all liabilities in an effort to enhance comparability of financial statements. Many U.S. and Japanese insurers believe that most non-life insurance liabilities should not be discounted and they have already expressed this view with the IASB.

Risk margins convey a level of uncertainty associated with future cash flows. These margins should be market-consistent and reassessed at each reporting date. The IASB has given high-level guidance with respect to risk margins, but has left the details related to their development to the insurance industry. One example of the high-level guidance is that operational risk can only be provided for if it is related directly to the liability itself. Acceptable approaches currently appear to include cost of capital, percentile, Tail Value at Risk, and multiple of standard deviation.

Service margins represent what market participants require for providing other services in addition to collecting premiums and paying claims. These margins should also be market-consistent. The investment management function in variable (and presumably other interest sensitive) contracts is an example of a service for which an explicit service margin may be established under this new framework. This concept is generally not considered in current pricing and embedded value techniques used by insurance companies.

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The primary implementation issue related to both risk and service margins is how to calibrate them.

Current Exit Value

The IASB is proposing that an insurer measure insurance liabilities at what it calls "current exit value." This represents the amount another party would reasonably expect to receive in an arm's-length transaction to accept all contractual rights and obligations of a liability. Under an exit value measurement framework, there are no requirements to break even at issue. Such a framework will prove challenging in terms of determining an appropriate level of risk margin, since the calibration is a very subjective process under an exit value framework. In particular, there is not currently a secondary market to transfer insurance liabilities. While one could look to recent acquisitions and reinsurance arrangements, the specific components rarely, if ever, become public information. However, these, combined with the retail market, could be taken into consideration in a hypothetical model.

A further point to note is that "current exit value" may or may not be equivalent to "fair value," as defined in the IASB's discussion paper on fair value measurement (to be used when fair value must be applied under IFRS). This discussion paper on fair value measurement is almost a word-for-word copy of Statement No. 157, which is FASB's version of fair value that has already been adopted. At the time this article is being written, the IASB has noted that there do not appear to be material differences between these two concepts, but it intends to explore this issue more thoroughly.

"Entry value" is another method of risk margin calibration covered in the Discussion Paper. Under the "entry value" framework, no gain or loss at issue would arise, since risk margins would be calibrated to the premium received less acquisition expenses. The IASB has rejected this approach in favor of current exit value, even though the CFO Forum, a discussion group made up of the Chief Financial Officers of 19 major European insurers, and GNAIE, a group made up of North American and Japanese insurance companies, lobbied for an entry-value type approach.

Own Credit Standing

The measurement of liabilities should include the effects, if any, of the credit characteristics of the liability (insurer's credit standing). In the Discussion Paper, the IASB wants the impact of this item to be disclosed. This issue has been rather controversial to some actuaries and accountants, although the IASB does not believe the impact will be large.

To be consistent with a fair value measurement of other financial instruments, the IASB has said the creditworthiness of the insurance contracts should be reflected in the measurement of the liability. The implicit assumption is that the transfer is to a third party of similar credit standing. This topic has generated much discussion—many do not agree with the rationale of reducing liabilities when a company's financial condition deteriorates. However, in a well-regulated market with guaranty funds, it is not expected that this will have a significant impact on the level of reserves ultimately held under IFRS Phase II. There may be other offsets to this potential reduction of liabilities that still need to be explored.

For example, if a cost of capital approach is used for deriving risk margins, an entity's cost of capital will increase as credit standing declines, implying a higher risk margin and therefore higher liabilities. Also, actuarial models sometimes already reflect the effects on pricing of credit standing indirectly via lapse rates, e.g., for life insurers.

Treatment of Future Renewal Premiums

The Discussion Paper indicates that future premiums would be included in the liability calculation only to the extent that either:

1. The insurer has an unconditional contractual obligation to accept premiums whose value is less than the value of the resulting additional benefit payments; or

2. They are required for the policyholder to continue to receive guaranteed insurability at a price that is contractually constrained.

This is a controversial issue with respect to North American style universal life and flexible annuity products, since current pricing techniques include an assumption for future expected premiums. If future expected premiums cannot be taken into account, there may be a significant loss at issue in today's products, largely due to heaped commission structures.

Unit of Account

The liability, including the determination of risk margins, should be determined on a portfolio basis. "Portfolio basis" refers to insurance contracts that are subject to similarly broad risks and managed together as a single portfolio. Determining risk margins on a portfolio basis means that one must exclude the benefits of diversification between portfolios.

Deferred Acquisition Costs (DAC)

Under the framework described by the Discussion Paper, there will be no separate DAC asset to account for the investment the insurer makes in the customer relationship. Acquisition costs are to be expensed when incurred, as they play no direct role in determining current exit value.

Discretionary Participating Features and Universal Life Contracts

In the IASB's current view, policyholder participation rights consisting of dividends and excess interest credits for life insurers do not create a liability until the insurer has an unconditional obligation to policyholders. A prior claim without an obligation should not be recognized as a liability; the amount expected to be paid in the future should be treated as part of equity. In assessing whether an insurer has a constructive obligation to pay dividends to participating policyholders, the IASB will rely on its Conceptual Framework and IAS 37, "Provisions, Contingent Liabilities, and Contingent Assets." This could potentially be a large issue for U.S. participating and interest sensitive life and annuity products, since current pricing takes into account expected credits to policyholders and not just guaranteed payments.

Summary

The Discussion Paper provides for significant changes to financial reporting for insurance contracts and related activity under IFRS.

The anticipated timeline for IFRS Phase II for insurers is as follows:

- An Exposure Draft is expected to be issued in late 2008.
- A final standard is expected to be adopted in late 2009.
- Implementation is projected to become applicable for 2011.

> The current events should be a wake-up call to U.S. insurers, as preparation for managing under a current exit value approach can take several years.

Many European companies have been pilot testing a "current exit" value type standard for several years; therefore, most of these companies will be prepared.

However, as discussed earlier in this article, the accounting changes in Europe are having a domino effect in the United States. While several of the large U.S.-based insurance companies have been in tune with the development of the proposed guidance, others appear to be largely asleep at the wheel, probably because they may not have appreciated the significance of US GAAP aligning with IFRS. The current events should be a wake-up call to U.S. insurers, as preparation for managing under a current exit value approach can take several years. The competitive landscape is changing and action is required. $

The Siren Call of Models—Beware of the Rocks

by Henry W. Siegel

As actuaries, we are uniquely concerned with both measuring the past and projecting the future. We look at the past in order to get insight into the future, but we can't assume that the past will always continue into the future.

One of the most common misunderstandings about actuaries is that we forecast the future. In fact, we project the future, we don't forecast it. The problem is, sometimes we forget this.

History 101

Many years ago I was involved in pricing the first GICs. Not directly, but in an oversight capacity. We looked at various scenarios—I think it was the first steps in a stochastic model and I can still remember some of the conversations. We noted early that a hump pattern (an increase in interest rates followed by a decrease) was good, so long as the decrease eliminated capital losses when the GIC ended. We also noted that a straight increase in interest rates was bad. Very bad.

We discussed this: what happens if interest rates go up to 12 percent, half a percent a year from when we priced it? "That can never happen," was the response—and it seemed reasonable. After all, this was around 1975 and interest rates since WWII had been stable, increasing slightly, for many years. Surely interest rates could never go so high—the government would do something first. Well, you know how that worked out. The government decided that curbing inflation was more important than keeping interest rates down.

There have been lots of other times when the crystal ball was cloudy:

- Buy Junk Bonds (Executive Life)
- Invest in Mortgages and Real Estate (Confederation Life)
- Assume normal lapses on lapse supported business (Long-term Care and Canadian Term-to-100)

But the classic example is Long-Term Capital Management. Every actuary should read "When Genius Failed," the story of this failure. For those unfamiliar with this, the Long-Term Capital Management hedge fund had Nobel Prize winners (among them Scholes, as in Black-Scholes) and many other extremely bright and successful people. Their fatal flaw was they believed their models.

They thought they had diversified their risks. They had invested in securities in many countries; if one went down, the others would provide stability. But then came the Asian Flu and the Russian crisis and suddenly EVERY country's securities went under. Then their competitors got wind and started moving against them. So the company would have collapsed if the banks hadn't bailed them out. There was a more complete article on this in *The Actuary* back in August.

The Future

So you might be wondering why this all matters to financial reporting actuaries. It matters because there are proposals in the market that don't seem to have learned these lessons.

For instance, the International Accounting Standards Board is suggesting that it's OK to accrue future expected profits on the day a policy is issued. The American Insurance Industry generally opposes gains at issues, the Academy Task Force on IFRS generally opposes it in all but the rarest circumstances, but some accountants and regulators on the international front seem less concerned.

"Surely there are times you *know* you're going to make a profit" some have said, even though the future remains as cloudy as ever. "Our models show that we'll have gains" others say, stubbornly believing their models will turn out to be real.

We've seen gains at issue before. Enron used it. Many sub-prime lenders used it. What makes us think it makes sense for insurance policies? If I were allowed to issue only one required piece of guidance for life accounting, "no gain at issue" would be it.
Another issue involves adjusting for portfolios with diversified risk. "We can reduce our required capital because we have diversified our risks. If we lose money on mortality on our life insurance, our annuities will bale us out!" they claim, ignoring that the people with annuities have different demographics than those with life insurance and that the mortality changes may occur at ages that affect the two busi-

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nesses differently. "When things go wrong, all correlations approach 1" should be a lesson learned from Long-Term Capital Management but some regulators seem willing to go along with a diversity credit.

The Society announced on the day I am writing this that they've completed "a research project that explored the covariance and correlation among various insurance and non–insurance risks in the context of risk based capital." I was happy when I saw this announcement since I think it's an area that shrieks for further research, but further examination showed a problem. There's a bibliography and a theoretical mathematical model, but there is no data to actually determine if any covariance or correlation exists! This is not a criticism of the SOA, but how can one argue for a diversity credit if there's no data to determine if it exists?

As actuaries, we need to avoid falling in love with our models. It's easy to become entranced with them because as actuarial students, our job was often to feed those models and we don't always step back and look at the whole picture. How many times have you lamented the inability of beginning students to notice when the model has produced something obviously wrong?

So as actuaries we need to be conscious that the future is uncertain. No surprise there, I hope. Also, as actuaries we are uniquely qualified to explain that to those who do believe a model is real. I urge all Section Members to adopt this as a personal goal.

Given all the above, it may surprise you that I am confident about one aspect of the future. This is my final column as Section Chair and I am confident that the Section will continue to thrive. As I have said before, we are in a period of exhilarating change, when all the financial reporting paradigms we've known will be changing. Whatever replaces them, financial reporting actuaries will be even more essential in the future.

Finally, I want to thank the intrepid editor of the Financial Reporter, Rick Browne, for putting up with my "Just in time" style of writing. If you haven't written for the Financial Reporter, pick up a keyboard and send Rick an article.

And always remember:

Insurance accounting is too important to be left to the accountants! $

Potential Implications of IASB'S Preliminary Views on Insurance Contracts

by Leonard Reback

The IASB Discussion Paper on Insurance Contracts presents the preliminary view that insurance liabilities should be valued at "current exit value" for GAAP financial reporting purposes. See the article in this issue "An International Financial Reporting Standards (IFRS) Phase II Discussion Paper Primer" by Tara Hansen and Mark Freedman for a more detailed examination of the preliminary views expressed in the Discussion Paper. Some of the implications of those views may be surprising. A few are enumerated below.

Credit Standing

As the Discussion Paper is currently written, the impact of an insurer's credit standing will be a factor in the discount rate for its liabilities. If the credit standing were to decrease, it would cause liability values to decrease, increasing income and surplus. Conversely, if credit standing were to improve, it would cause liability values to increase, reducing income and surplus. It may be difficult to explain these gains when there is a credit downgrade, generally thought of as a "negative" event, or the losses when there is a credit upgrade, which is generally considered a "positive" event.

Earnings Volatility

Another implication is the potential for earnings volatility. It may not be surprising that if there is duration, convexity or hedging mismatch between the assets and liabilities there could be earnings volatility from changes in interest rates or other capital market fluctuations. However, even where assets and liabilities are well matched, there could be volatility if some assets are accounted for in the income statement on a basis other than fair value (or a similar measure). After all, current accounting does not require changes in fair values of securities or most other financial instruments to flow through net income. And certain invested assets, such as real estate, are not even eligible for a fair value option.

Earnings volatility might also emerge from other sources, even if liabilities are duration matched and well hedged. All of an insurer's liabilities would reflect its own credit standing. Invested assets, however, typically have diverse credit ratings, not necessarily equal to the insurer's. Thus, if there were a non-parallel shift in credit spreads, the asset and liability values would not move consistently, creating earnings volatility.

For example, assume an insurer has an AA rating. And assume that AA credit spreads relative to the risk-free rate increase by 10 basis points. Further, assume that the credit spreads on invested assets increase by an average of 20 basis points. Even if assets and liabilities were otherwise well matched and properly hedged, the non-parallel shift in credit spreads would cause the asset fair values to decrease more than the liability current exit values, generating a potentially large loss.

This could occur if there is a perception in the market that an insurer's credit standing has changed, even if no change has actually occurred. An example could be presented from recent events, as follows. Assume that during the recent sub-prime credit crisis some insurers were perceived by the market to be exposed to sub-prime credit risk. The credit spreads for their own obligations would have increased, even if in reality they had no such exposure. This increased credit spread, however, would likely have been considered consistent with observed market cash flows, and thus may have been required to be reflected in discounting those insurers' liabilities. This would have generated a reduction in the current exit value of an insurer's liabilities, generating potentially large gains, whether or not the insurer's creditworthiness was actually impacted. If those credit spreads reversed in subsequent periods, the gains would reverse, producing large losses. In essence, the market's view of a company's credit risk would likely be deemed "correct" for purposes of valuing the liabilities, whether or not that view was accurate.

Also, changes in liability experience and assumptions would create earnings volatility, similar to current DAC unlocking on FAS 97 contracts. For example, if current estimates of future mortality were to change, that change would impact the current exit value of the liabilities immediately, and would impact net income. However, there would be no corresponding change in invested assets (although reinsurance assets might be impacted). Depending on the direction of the change in liability current exit value, a large gain or loss could result. These gains or losses could be greater than the impacts currently seen from DAC unlocking on FAS 97 contracts, because DAC unlocking impacts are mitigated by the amortization ratio, which is typically less than 100 percent. With current exit value changes, there would be no such mitigation. And under current exit value these changes would also impact contracts currently accounted for under FAS 60 under US GAAP.

Gain or Loss at Issue

Gains or losses at issue are another possibly surprising impact. Under current GAAP, gains generally do not occur upon issuance of a contract. Losses upon issue are rare, and are generally limited to situations where acquisition costs are not recoverable, or where the present value of expected benefits and expenses under the contract exceed the present value of premiums.

Under the IASB preliminary view, gains at issue would be permitted (although the IASB indicates that they expect this to be rare), and losses may occur even if expected premiums are adequate to cover expected benefits and expenses. This may happen if the premiums are adequate to cover benefits and expenses, but not adequate to cover benefits and expenses plus a risk margin consistent with that of other market participants.

Another situation where a loss may occur at issue is when an insurer has a particularly efficient expense structure and builds the resulting low expenses into its pricing, generating a low premium relative to the rest of the market. Because the market level of expenses is higher than that of the insurer, the insurer may need to assume those higher expenses when determining its liability value. And where those expenses are higher than what was assumed in determining the premium, there may be a resulting loss at issue. Of course, if the insurer's own expected low expenses do materialize, the insurer will realize higher profits as those expenses emerge.

Furthermore, the IASB preliminary view restricts the recognition of future premiums on a contract, unless one of three conditions is met:

1. The insurer can compel premium payment;
2. Including the premiums and associated benefits increases the liability value; or
3. The insured must pay the premium to retain guaranteed insurability.

This would seem to preclude recognition of future premiums on most universal life contracts in excess of the minimum amount needed to cover contractual charges. It would also seem to preclude recognition of any future premiums on most variable annuity contracts that are classified as insurance contracts. Any such excess premiums would be considered an unrecognized customer relationship intangible.

This provision appears to make losses on issue of these contracts likely. After all, premiums in excess of the bare minimum to keep the contract in force are generally assumed in pricing the contract. Thus, those premiums typically include elements to recover acquisition costs. If those premiums cannot be recognized, a loss at issue may result.

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Similar concerns may apply to lapse-supported products. The beneficial policyholder behavior, in this case lapsation, may not be recognizable under the preliminary views. Therefore, even likely future lapses may need to be excluded from the liability valuation. This could also generate losses at issue.

A mechanism which might have the opposite effect is the IASB's preliminary view on the restriction of recognition of dividends (on participating contracts) and interest credits in excess of minimum guarantees (on UL contracts) to those which the insurer has a legal or constructive obligation to pay. It is not entirely clear how strong the expectation for payment of the dividend or interest credit would need to be in order to be recognized. If dividends and interest credits that were assumed in pricing cannot be recognized in the liability valuation, this could generate a gain at issue.

Business Combinations

Assets and liabilities acquired in a business combination are required to be initially measured at fair value under FASB Statement No. 141, and under IFRS 3 for entities following IASB standards. As of the issuance of the Discussion Paper, the IASB had not identified any significant differences between current exit value as described in the Discussion Paper and fair value. If that remains the case, then current exit value, as described in the Discussion Paper, may become the valuation basis for insurance contracts acquired in business combinations—a development that could have interesting implications.

For example, if a company is acquired in a competitive bidding process, the fair value of the acquired assets net of the current exit value of the acquired liabilities may well exceed the purchase price. After all, all the other companies that participated in the bidding process would have required receiving more assets from the selling company. But in situations where an entire company is acquired, the resulting difference could be considered a goodwill asset.

If only a block of insurance contracts is acquired, however, rather than an entire company, there would be no goodwill. Under the preliminary views expressed in the Discussion Paper, any difference between the purchase price and the net of the fair value of acquired assets over current exit value of acquired liabilities would be considered a loss (or gain, if applicable) at the time of the transaction.

Summary

The preliminary views expressed in the IASB Discussion Paper on insurance contracts may generate some surprising and, perhaps, disturbing results. Because future accounting standards for entities covered by the IASB and by FASB may be impacted by the results of this project, interested actuaries should follow these developments closely and make themselves heard in the process. $

Risk Margins to the Non-Market Risks under FAS 157: Suggested Approach

by Vadim Zinkovsky

The recent FASB Statement 157—Fair Value Measurement—describes, among other modifications to the current fair value methodology, addition of risk margins for the risks other than capital market risks. In particular, for investment guarantees on variable annuities, GMxB's (e.g., Guaranteed Minimum Accumulation Benefit—GMAB, Guaranteed Minimum Withdrawal Benefit—GMWB), which are subject to fair value accounting (FAS 133), one major risk category is policyholder behavior risks.

This paper describes a methodology to calculate risk margins attributable to these types of risks. While examples will focus on policyholder behavior risk for GMxB's, the approach may be extended to a broader range of non-market risks and other insurance products.

For purposes of the risk-neutral liability value calculation (a current, widely used FAS 133 method), certain assumptions are made about future policyholder behavior. Let's call this set of assumptions the baseline. The policyholder behavior risks arise from a chance that corresponding assumptions will be different from the baseline assumptions and will adversely impact the value of guarantees. Such risks create an uncertainty about future liability cashflows and clearly affect the liability transfer price, or "exit value," described by FAS 157.

Systematic vs. Idiosyncratic Risks

One question is what type of risks should be considered: a systematic deviation from the baseline or a random noise with the mean being the baseline assumption.

In the capital markets world, CAPM assigns compensation in form of higher risk premium only for non-diversifiable or systematic risks. Systematic risks are the risks simultaneously affecting the entire capital markets. Idiosyncratic risks are risks specific to individual assets.

To extend this approach to policyholder behavior risks, an example of systematic risk would be the risk of a large number of policyholders simultaneously switching to a lower lapse "regime." A random noise type of a risk, where lapse experience each period fluctuates around the mean assumed in pricing for each policy/cohort, is an example of an idiosyncratic risk.

In terms of its impact on the fair value of liabilities, the systematic behavior risk of this nature may result in more severe outcomes than a random fluctuation type of risk. Note that a simple application of the CAPM principles suggests that diversifiable risks should be excluded from the margin calculation. Random noise types of risks seem to be of such nature.

While it's not suggested to exclude idiosyncratic behavior risks from the margin calculation entirely, the focus here is going to be on systematic risks.

Wang Transform

One possible methodology for the calculation of risk margins is a technique called Wang transform (Wang 2000, Wang, et al, 1997). For an arbitrary insurance risk X, where X is, for example, a distribution of insurance losses, Wang transform describes a distortion to the cumulative density function (CDF) F(X). The distorted CDF F*(X) then can be used to determine price of risk, where the premium equals the expected value of X.

In a context of GMxB-specific risks, e.g., behavior risks, each observation of the variable X can be viewed as a market-consistent value of liabilities corresponding to a certain state, represented by a set of policyholder behavior assumptions. Thus, a range of possible sets of policyholder assumptions will translate into a distribution of liability values, where each of them will correspond to a market-consistent (risk-neutral) value under a given set of behavior assumptions. In particular, the value corresponding to the baseline set of assumptions is the baseline value of liabilities, as determined using the current FAS 133 methodology.

Wang transform as applied to non-market risks of GMxB formulaically is as follows:

$$F^*(X) = \Phi\left[\Phi^{-1}(F(X)) - \lambda\right]$$

where X – distribution of fair value of liability resulting from stochastic nature of non-market risks;

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F(x)—original "loss" cumulative density function. X's are ranked from the lowest loss (best result) to the highest,

Φ—cumulative distribution function for standard normal;

Φ^{-1} inverse of Φ;

λ—market price of risk, a parameter.

F*(X)—transformed, or "pricing" distribution.
Expected value under the transformed distribution E(X) equals the new price adjusted by the risk margin.

For normally distributed risks, Wang transform applies a concept of Sharpe ratio from the capital markets world. However, it can also extend the concept to the skewed distributions.

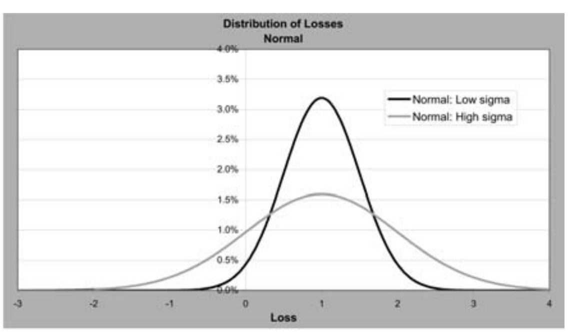
Basically, the distribution *F(x)* describes the real world set of probabilities attributable to a range of possible outcomes, while *F*(x)* describes risk-adjusted probability distribution for the range of outcomes.

Essentially, Wang transform makes the probability of severe outcomes higher by reducing their implied percentile. This bears similarity with the risk-neutral valuation technique for the capital market instruments. Indeed, Wang transform replicates the results of risk-neutral pricing, Black-Scholes formula in particular, under a set of additional conditions, such as market completeness, availability of the risk-free asset, etc. Results of CAPM is another special case of the Wang transform.

Wang transform enables us to calculate a margin to the fair value of liabilities using notions of price of risk, usually denoted by λ (lambda), and a measure of risk which is determined by the entire distribution. Possible methods to estimate lambda will be discussed later in the article.

Case 1: Normal Distribution

Consider two normal loss distributions, Distribution 1 and Distribution 2, with same means equal 1 and standard deviations equal 0.5 and 1, respectively.



If the price was determined as an expectation of losses, the two risks would've had the same price equal to the mean.

However, Distribution 2 is clearly more risky and, as a compensation for risk, should command a higher price.

This is consistent with the CAPM efficient frontier theory where a riskier asset would have higher expected return. Since both distributions are normal and have same means, standard deviation can be used as a measure of risk here, similarly with the CAPM approach. An assumption of risks normality is also an underlying assumption of the CAPM.

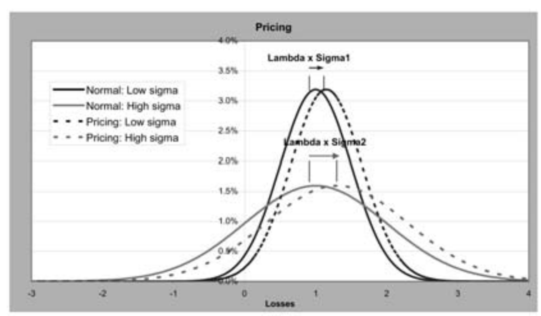
Now, apply *Wang transform* to the original loss distribution in order to get the *pricing* distribution, i.e., the one that can be used to get price as expected value of losses.

For normal distribution, *F(X)* with mean and standard deviation μ and σ, the transformed distribution *F*(X)* is also normal, however with the parameters $\mu+\lambda\sigma$ and σ.

Thus, the price as an expectation of the transformed distribution is expressed simply as: $E^*[X] = E[X] + \lambda\,\sigma[X]$,

Where $E^*[X]$ – is the price of the margin, calculated as expected value of the transformed distribution.

See the graph below showing the transform for the two normal distributions:



Assume that the state with the unshocked policyholder behavior assumptions corresponds to the mean result of the loss distribution: $E[X]$ = Baseline Risk-Neutral value, the risk-neutral value corresponding to the baseline set of policyholder assumptions.

So the margin for additional non-market risk equals just $\lambda\,\sigma[X]$,

Value with margin = Risk-Neutral Value + $\lambda\,\sigma[X]$.

Thus, risk margin is proportional to the standard deviation of a normally distributed risk. Under the normality assumption, a distribution with higher standard deviation will have higher risk margin, which in this example is Distribution 2.

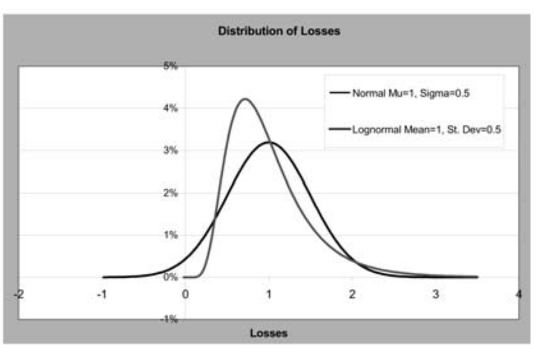
This result is analogous to the CAPM/Sharpe ratio conclusion which assigns a higher compensation to a risk with higher standard deviation of return, that is, standard deviation is a measure of risk.

Case 2: Long-tailed distribution – Lognormal

The normal distribution, being a two-tailed symmetrical distribution with a range of outcomes from $-\infty$ to $+\infty$, is not a very realistic one for modeling behavioral risks. If one thinks of a range of policyholder behavior outcomes, e.g., rider utilization scenarios, it's reasonable to assume an extremely efficient behavior will increase the value of liabilities quite significantly. Intuitively, perfectly efficient behavior scenarios should be low probability events, perhaps with lower probabilities than normal distribution implies. Such scenarios will define the right tail of the liability value distribution due to variability in policyholder behavior.

On the other hand, the left tail of the distribution will be impacted by extremely inefficient behavior scenario types. An example of perfectly inefficient behavior is for example an assumption of zero rider utilization rate. But under this assumption the liability value will be naturally capped by present value of fees with the minus sign. Thus, *a distribution with a longer tail for higher losses and with outcomes limited by the lowest (best result: e.g., no claims) value should be more realistic.*

One such distribution with some well-behaved properties is *lognormal*. Here is how it compares with the normal distribution:



		Lognormal Parameters	
		Mu	-0.11
		Sigma	0.47
Normal		Lognormal	
Mu=1,	1.0	Mean=1,	1.0
Sigma=0.5	0.5	St. Dev=0.5	0.5

The distributions shown on the graph have same mean and standard deviations. However, the lognormal has "fatter" right tail for high losses. We'll see below that Wang transform assigns higher risk margin to the lognormal distribution in this example.

For the lognormal distribution the transformed CDF per Wang transform is also distributed lognormally. If the original *F(X)* is lognormal with parameters μ and σ, the transformed distribution *F*(X)* is also lognormal with parameters $\mu+\lambda\sigma$ and σ.

The mean of the lognormal distribution (μ, σ) equals: $e^{\mu+\frac{\sigma^2}{2}}$.

So the liability value with the margin, calculated as the mean of the transformed distribution, equals: $e^{\mu+\lambda\sigma+\frac{\sigma^2}{2}}$.

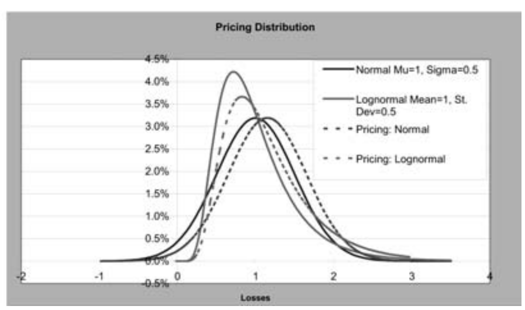
Again, assuming that the expected value under the original, "real world" loss distribution corresponds to the baseline liability value, E[X] = Baseline Risk-Neutral value, we'll get the following result:

Value with margin = Risk-Neutral Value*$e^{\lambda\sigma[X]}$.

And

$$Lognormal\_Margin = Value\_with\_Margin - RNValue = Lognormal\_Mean\{e^{\lambda\sigma} - 1\}$$

Here is how transformed distributions look:



Assuming λ=0.3,
expected values of transformed "pricing" distributions are:
1.15 – normal,
1.152 – lognormal

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Thus, lognormally distributed losses resulted in a slightly higher price.

Note that both mean and standard deviation of the original loss distributions were the same.

Margin adjustment to the price is as follows:
Normal: New Value = Old price + $\lambda\,\sigma[X]$
Lognormal (-.11, 0.47): New Value = Old Price x Exp $(\lambda\,\sigma[X])$

As mentioned before, Wang transform *increases probabilities of severe outcomes.*

As an example, consider the 99.5th percentile of our original lognormal distribution L(-.11, 0.47) which equals 3.02. Under the original distribution, probability of an outcome in excess of 3.02 is 0.5 percent. The Wang transform changed the original lognormal to the lognormal with parameters L(0.03, 0.47). The transformed distribution assigns higher probability to the outcomes greater than 3.02, equal 1.14 percent.

Recommendation for GMxB's Risk Margin Calculation

In practice, modeling non-market risks stochastically is a difficult task, both computationally and in terms of underlying assumptions. Take as a special case policyholder behavior. Multiple parameters need to be estimated to describe stochastic processes for lapse, partial withdrawal, rider utilization, cancellation, optional step-ups, etc. Usually, there is very little historical information available for such types of calibration. If each of these risks is modeled stochastically, even in its simplest form, at least an estimate for the standard deviation of each risk should be needed. The resulting liability value distribution is likely to be of some arbitrary shape other than a well-behaved distribution. However, there is no reason to believe such a distribution will be any better in terms of its predictive power.

At the same time, a set of "worst case" type of behavior assumptions may be defined as part of sensitivity analysis by pricing actuaries and the liability value estimated.

Fitting Distributions

Moreover, there may be a certain probability assigned to a state described by a set of shocked policyholder behavior assumptions. For example, such estimates may be needed for economic capital calculation purposes.

In any case, making an assumption of the probability of such "shocked behavior" would define a point on the tail of the liability value distribution due to an uncertain nature of policyholder behavior. Along with the assumption that the baseline set of behavior assumptions corresponds to the mean value of the liability distribution, this defines two points on the liability CDF.

For two-parameter distributions, such as normal or lognormal, defining two points on the probability distribution curve is sufficient to find the distribution parameters.

Assume, as an example, that the "shocked behavior" liability value corresponds to the 99.5th percentile. We'll show below how the mean and the 99.5th percentile, can be used to uniquely identify parameters of the normal or lognormal distributions Ì and Û.

Normalizing Distribution

Real life distributions of liability market values may span over a wide range of outcomes. However, the lognormal distribution we've considered so far, with parameters μ=-0.11 and σ=0.47, denote it L(-0.11, 0.47), has its domain between [0; ∞], as any lognormal distribution. In order to map the results of a real life distribution to the domain of lognormal distribution a one-to-one relationship needs to be defined. A simple linear transform will describe such a relationship:

$$X_{real} = A+B*X, \qquad (1)$$

Where,

X_{real} – real life outcome variable,
X – lognormal variable, L(-0.11, 0.47).
A and B – constants to solve for.

Two equations linking the two "observed" values of the liability value, baseline and 99.5th percentile to their mapped values to the lognormal L(-.11, .47) will uniquely identify constants A and B.

Here are the main steps of the derivation of parameters A and B. The mean of the lognormal distribution:

$$Mean = e^{\mu+\frac{\sigma^2}{2}}$$

The 99.5th percentile for L(-.11, 0.47) equals 3.02 or approximately four standard deviations away from the mean, and variance (standard deviation squared) of the lognormal distribution equals:

$$Variance = e^{2\mu+\sigma^2}(e^{\sigma^2}-1)$$

Since the real life distribution is just a linear transform of the original distribution, the same relationship between the mean and 99.5th percentile must hold: four standard deviations apart.

Therefore, standard deviation of the original distribution equals:

Sigma = (99.5^{th} percentile - Mean)/4.

Next, constant B equals 2 x Sigma.

Next, recall the result of the Wang transform for the lognormal distribution.
Price with the margin equals:

$$\textit{Price with Margin } = e^{\mu+\lambda\sigma+\frac{\sigma^2}{2}} = \textit{Orig Price} * e^{\lambda\sigma}$$

Going back to the real life distribution X using formula (1) and remembering that *Mean=Original Price=1:*

Margin = A + *B*PricewithMargin – (A+ B*LMean)= B*Lognormal margin*

$$\text{Margin } = 2 * \sigma * \{e^{\lambda\sigma} - 1\} \qquad (2)$$

where *LMean* – mean of the lognormal distribution L(-.11, 0.47), equal 1;
and standard deviation σ = (99.5^{th} percentile - Mean)/4.

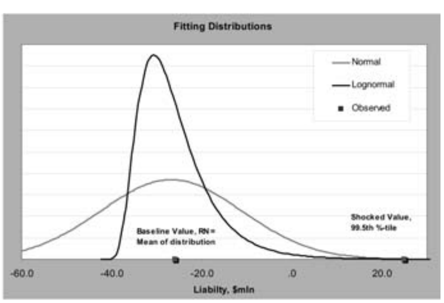
GMAB Example

In order to have a better feel of the margin adjustment magnitude consider a generic GMAB block. Risk-neutral valuation under the baseline and the shocked behavior sets of assumptions (corresponding to 99.5th percentile) produce the following results, respectively:

In $millions:

	PV Claims	PV Fees	Net
Baseline:	145	171	-26
99.5^{th} percentile:	170	145	25

The graph below illustrates how the distributions could be fit to the two "observed" points. The linear transform described by formula (1) to map the domain of lognormal to the real life range of outcomes is used:



Again, lognormal distribution looks more realistic to represent variability in policyholder behavior. It has a natural minimum point while the normal distribution extends far to the left. Also, it generally has fatter tail although it manifests itself only in extremely high percentiles.

Risk Margin Calculation

Assume λ=0.3.

For the normal distribution: Margin = λ x St. Deviation,
Where St. Deviation can be calculated from (99.5^{th} percentile – Mean)/2.576
= $19.8 million

For the lognormal distribution use formula (2):

Margin = 2x St. Deviation[$e^{(\lambda x0.47)}$ - 1]

Where
St. Deviation = (99.5^{th} percentile – Mean)/4 = $12.6 million

Thus the margin adjustment equals:

Normal: 0.3 x $19.8 million = $5.9 million

Lognormal: 2x $12.6 million x [$e^{(0.3x0.47)}$ - 1] = $3.8 million

Thus, fitting lognormal distribution resulted in a lower margin adjustment.

Baseline Assumptions vs. Risk Margin

The margin captures the risk of non-market assumptions being more adverse than those assumed in the baseline pricing. But what if a more conservative set of assumptions is used in the baseline product pricing? One should expect a lower margin. Assume for example, two companies valuing an identical product using different sets of assumptions. Company 1 would use a set of assumptions consistent with the baseline result above, call it Original. Company 2 would use a more conservative non-market assumptions set. As a result, net baseline liability value will increase from -$26 million to 0.

In $millions:

	PV Claims	PV Fees	Net
Original Baseline:	145	171	-26
Conservative Company Baseline:	160	160	0
99.5^{th} Percentile:	170	145	25

Note that the value of the 99.5^{th} percentile would be identical for both companies since the product is identical. Applying formulas (1) and (2) above produce the following liability value distributions:

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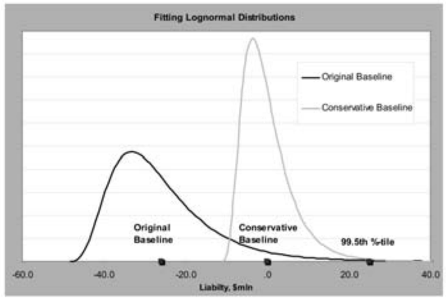

Note how the distribution for the conservative Company 2 is less disperse. The margin for non-market risks is also lower for Company 2.

Margin (Original Company) = $3.8 million
Margin (Conservative Company) = $1.9 million

As the conservative estimate is approximately half-way between the original baseline and 99.5th percentile, the margin to the conservative estimate is also around a half of the original margin.

Interaction of Risks

So far, the focus has been on a single non-market risk, behavior risk in most of the examples. Generally, there may be more than one source of the non-market risk, for example policyholder behavior and mortality improvement. In this example an assumption of a zero correlation between policyholder and mortality risks seems to be a reasonable one. To generalize for n uncorrelated non-market risks, the formula for the standard deviation of the joint distribution is as follows:

$$\sigma_{Joint} = (\sigma_1^2 + \sigma_2^2 + \ldots + \sigma_n^2)^{0.5}$$

Strictly speaking, this formula is accurate if each risk is normal. It's suggested to also use the same formula for the lognormal assumption.

The resulting standard deviation of the joint distribution then should be substituted to the formula (2), if lognormal distribution is assumed.

Summary: Recommended Risk Margin Calculation for GMxB, Non-market Risks

1. Determine market-consistent values of the guarantee corresponding to two sets of non-market assumptions, baseline and shocked. Assign a probability to the shock value, e.g., 99.5th percentile.
2. Take the difference Shocked – Baseline. This will be equal X standard deviations depending on the percentile assignment in step 1.
   a. E.g., under the lognormal with Mean=1, St. Dev=0.5, 4 x *Standard Deviation.* Therefore, *St. Deviation = (Shocked – Baseline) / 4.*
3. Repeat step 2 for each uncorrelated mortality risk, if applicable.
   a. Calculate resulting standard deviation σ_{Joint} as: $\sigma_{Joint} = (\sigma_{beh}^2 + \sigma_{mort}^2)$
4. Calculate the risk margin (added to the baseline value):
   a. Normal: Margin = λ x St. Deviation,
   b. Lognormal: : 2x St. Deviation $[e^{(\lambda x 0.472)} - 1]$

Recommended distribution: *Lognormal.*

Estimating Lambda

The meaning of the parameter lambda in the Wang transform is price of risk. That is, it shows by how much the fair price will increase should a measure of risk increase by one unit. In this general context, the lambda is basically independent of the nature of risk. It's rather more of a characteristic of the entity bearing the risk and should be closely related to the overall risk tolerance of the entity.

In order to estimate lambda, two approaches are suggested here, company-specific and market.

With the company-specific approach the question should be asked: how much extra return in excess of the risk-free rate the company requires per accepting an additional marginal unit of risk. In a narrower context, this could be answered by the return on capital targets for new products. For example, if a company expects risk-adjusted return on capital (RAROC) of 8 percent in excess of the risk-free rate on an after-tax basis, and the required economic capital equals four standard deviations of the change in economic value the lambda here equals 8 percent x 4 = 32 percent. Here an assumption is made that one standard deviation equals one unit of risk.

The market approach would extend the definition of lambda to capital markets which is essentially a definition of Sharpe ratio. The Sharpe ratio based on historical returns for a broad range of domestic equity indices ranges between 0.3 and 0.4. For example, the Sharpe ratio for the S&P 500 historically is about 0.4. Therefore, a Sharpe ratio in a range of 0.3 -0.4 should be reasonable. $

References:

1. K. Dowd, 2005, "Risk and Reward" Financial Engineering News, July/Aug. 2005, Issue 44.
2. S. Wang, 2000, "A class of distortion operators for pricing financial and insurance risks", Journal of Risk and Insurance, 67, 15 – 36.
3. S. Wang, V. Young, H. Panjer, 1997, "Axiomatic characterization of insurance prices", Insurance: Mathematics and Economics. 21: 173 -183.

A Critique of Fair Value as a Method for Valuing Insurance Liabilities

by Darin Zimmerman

Fair value will soon be used to value insurance liabilities. It is not a question of "if" but "when." This should not be viewed as the apocalypse or a holy grail. Like virtually every other intractable problem in life, there are no solutions, only trade offs. There are advantages to this development, but also drawbacks. I offer this critique of fair value as a method of valuing insurance liabilities, not as a call to abandon fair value or forestall its implementation, but to highlight the challenges the industry will face in this transition. It is my hope that by bringing these challenges to the forefront of people's minds, we will develop practical valuation techniques that make the most of the advantages of fair value, while diminishing the drawbacks as much as possible.

It is also important to note that the following disclaimer is not perfunctory. I offer these opinions as my own, and they in no way reflect the opinions or positions of my employer, Transamerica Reinsurance, or its parent, AEGON.

Who's Asking?

I've made the point in numerous actuarial presentations, that financial statements are a complicated answer to a simple question: "When will I get paid?" Since many different people ask this question, there are many different answers that an insurance enterprise can supply. The regulators ask this question on the behalf of policy holders, and so statutory (or regulatory) financial statements present a different picture than US GAAP financial statements, which are, generally, answering that question for corporate debt holders. Equity analysts ask that question on behalf of their clients, common share holders, and find the information in embedded value financial statements very useful. The insurance enterprise's pensioners are also interested in getting paid and are probably interested in the company as a going concern. And of course, you can't forget everybody's favorite uncle, Sam—for the tax man wants to get paid as well and he is increasingly suspect of overly conservative valuations that comfort the policyholder.

In so far as it is at least rude, if not disconcerting, to acknowledge that capital markets reduce the promises we sell to simple figures of dollars and cents, fair value is obviously not a candidate for reporting to policy holders, or their proxy, regulators. Solvency and prudent conservatism will and should continue to dominate the financials produced to tell the policy holders when they will get paid. But for debt and equity holders, fair value has the potential to provide better information about the risks a company writes and can even make the financial statements more comparable to other financial service industry enterprises. A friend of mine made the astute observation that U.S. insurance companies have become very adept at giving away free call and put options, because the accounting rules didn't force companies to value them. Under fair value accounting, "free" options become prohibitively expensive.

Rules versus Principles

There is no better demonstration of the axiom, "no solutions; only trade offs" than the question of whether valuation requirements should be rules-based or principles-based. This table presents some of the advantages and drawbacks of each:

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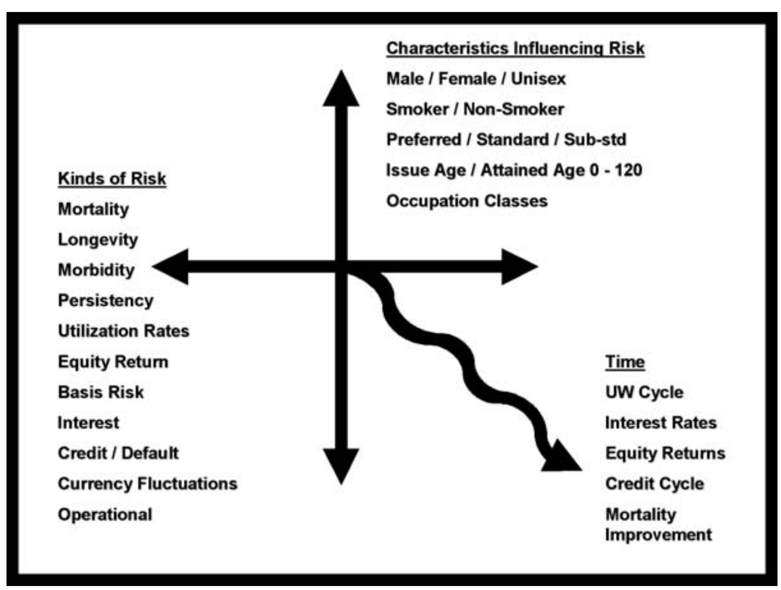
	Rules-based	Principles-based
Advantages	• Easier for regulators to audit • Easier for companies to implement • Makes commercial software easier to develop and use • Makes different companies' results more comparable • More objective	• Always makes sense • No incentive to manipulate product design (PD) • Encourages PD creativity • Diminishes systemic risk (Mistakes not industry-wide) • Actuarial focus is on price of risk, not accounting results
Drawbacks	• Does not always make sense • Easier to manipulate • New products can cause problems • Lack of accountability • Impedes creativity • Regulators can't admit mistakes and fix things	• More subjective • Harder for regulator to audit • Easier to commit fraud • Easier for actuary to make a bankruptcy-sized mistake • Requires powerful analysis tools and understanding • Requires better actuaries

History

Carpe diem—"Seize the day" is the rejoinder of artists around the world. They are constantly trying to sell us on the value of living in the moment because you never know what the future might bring. Well, most actuaries would characterize this as a dubious claim, to say the least! But apparently, the investment bankers have taken this advice to heart. They feel that all opinions of what the future holds are mere speculation, and no one person's opinion can be trusted more than another. They feel the price data as it exists today is the best measure of liabilities because it is an amalgam of all opinions precisely balanced by the invisible hand of The Market.

Well, just as I know night will eventually follow day, and spring will eventually follow winter, I know high interest rates will be followed by low interest rates and low interest rates will be followed by high. Likewise, the property and casualty actuary knows that the underwriting cycle will have a tight market followed by a loose market before returning to tight.

We do not know the frequency of the interest rate and underwriting cycles as precisely as the seasons, but we do know they exist. And even if our opinion of "high interest rates" and "low interest rates" changes over time, mean reversion exists because market actions are a result of human decisions, which cannot be memory free like the log normal interest rate and equity return generators we build. Historically, insurance liability valuation has sought to smooth out these cycles as another opportunity for diversification. Graphically it looks like this:



The best way to manage non-hedgable risk is through diversification. Insurance enterprises have always diversified individual instances of risk by combining them into portfolios of risk and they have been adept at developing products that contained several non-correlated kinds of risk to further the diversification benefit. And we have historically diversified our risks across time as well. The U.S. Statutory concept of the IMR (Interest Maintenance Reserve) and AVR (Asset Valuation Reserve) are methods of smoothing investment returns (that is, current period income) by amortizing credit gains and default losses, and capital gains and losses into income. And under US GAAP FAS 97, it has been very common for management's best estimate of future equity returns and interest rates to employ mean reversion to dampen the effects of capital market movements.

This is a perfectly acceptable approach ***PROVIDED*** that you have enough capital to ride out the entire cycle. In truth, we can never know this because these cycles are not as regular as the seasons.

Price versus Prediction

I've often made the point that asking an actuary to put a fair value on an insurance liability is asking him to do something completely foreign with respect to traditional actuarial work. All of our training has been geared toward predicting future benefits. (With call and put options, we assign probabilities to the range of possible future outcomes in order to calculate an expected value of benefits.) We can quibble all day over the discount rate used to calculate the present value of the benefits, but that's the easy part: predicting the future benefits is the hard part. And if you want to know how well an actuary does his job, all you have to do is wait to see how close his predictions of future benefits are.

In placing a fair value on an insurance liability, we are asking for something fundamentally different from a prediction of future benefits even though it is calculated similarly. With fair value (especially exit value) we are asking the actuary to predict a price at which a hypothetical transaction would take place. It's interesting to note that once the prediction is made, we can never check up on the actuary like we can with traditional actuarial work where all we need is patience. Once the hypothetical transaction date is past, any subsequent transaction would have a different in-force inventory, different interest rate conditions, and more information for experience studies.

When we speak of a liability's value, investment bankers and insurance actuaries are talking past each other. In placing a value on an insurance liability, the investment banker is trying to predict the unknowable present and the actuary is trying to predict the eventually knowable future. In a fair value world, the actuary must come to appreciate this subtle difference. Before I gained an appreciation for this difference, I used to enjoy pointing out the fact that, generally, market prices don't have predictive value. Forward interest rates don't do a good job of predicting future interest rate levels. Implied volatilities don't do a good job of predicting future actual volatility. And if a country's regulator greatly increases the capital requirements for a certain asset class, spreads on that asset class will widen as companies are forced to divest of that class, but the wider spreads do not increase the probability of default for the issuing companies. They merely reflect a new equilibrium point in the supply and demand for fixed income securities.

This lack of predictive value is not surprising given the fact that investment bankers aren't trying to predict the future, they are trying to predict the present. And in one sense, the investment bankers have the better argument: the most important aspect of any proposed insurance accounting system is that it must value assets and liabilities consistently. For the majority of assets, it is very easy to accurately predict their fair value. If we start on the left side of the balance sheet and we know the fair value of a group of assets that perfectly hedge a liability, then the liability value must match the value of the assets irrespective of what a good prediction of the future benefit payout is. This is one of those Truths that is truly self-evident.

Now it is fair to point out that in the insurance world, the situation where it is possible to construct a "perfect hedge" is exceedingly rare. It is more common to be able to construct partial hedges. Given this fact, the "art" of fair value will be in deconstructing the various risks so that the hedgable portions tie exactly to the value of financial instruments that would hedge the risk, and the remaining risks are valued consistently with the assets backing them.

Understanding Market Value Risk Margins

Even though one uses risk-free rates (which have no default margins) to calculate risk neutral scenarios,

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that does not mean risk neutral prices don't have risk margins embedded in them. The confusion is created when the three risk profiles are placed next to each other. The three risk profiles are risk averse, risk neutral and risk seeker. Someone who is a risk seeker will pay a margin to take risk. (A gambler plays at an expected loss for the privilege/thrill of gambling.) Someone who is risk averse will pay a margin to avoid risk. (Insurance premiums are higher than the present value of loss.) It is incorrect to interpolate between these two profiles and conclude someone who is risk neutral is indifferent to risk and will accept it without a margin.

In fact, risk neutral prices do contain a margin over the actuarially determined expected value. The amount of the margin is the precise amount that The Market has determined will compensate for assuming the risk.

The International Actuarial Association (IAA) has issued a white paper on risk margins at the request of the International Association of Insurance Supervisors (IAIS). In it, they describe four possible approaches for determining margins: 1) Explicit assumption (110 percent of current estimate, for example), 2) Quantile method (enough margin for 95 percent confidence interval, for example), 3) Cost of Capital method (enough margin to compensate at the cost of capital for the amount of capital needed to manage the risk), and 4) Other (implicit conservatism in assumptions or discount rates).

It seems the cost of capital method is the most promising for fair value. In order to get a value that doesn't exaggerate the effects of market movements the actuary will need to start with the total capital requirement for the product portfolio and will then need to strip out the hedgable risks. If he can estimate the risk margins within the prices for the hedgable risks, he can use his cost of capital to estimate what portion of the total capital is attributable to hedgable risks. After that, he should strip out capital related to asset risk (C3 in the United States). Then he can use his cost of capital with the remaining capital to calculate the market value margin that needs to be added to the current estimate of the non-hedgable risks in order to calculate the total fair value.

Risk Free versus Portfolio Yield

Many actuaries believe the current draft of the IASB Phase II exposure draft directs the actuary to discount projected cash flows using risk-free rates (less a spread to reflect the instrument's credit worthiness). Historically, actuaries have discounted at (a slightly conservative estimate of) an appropriate portfolio yield. It seems counter-intuitive that it shouldn't matter if the left side of the balance sheet is a well diversified portfolio of bonds, or if it is a single bond. In reality, the left side will affect the financials through capital. An entity will need less capital to manage insurance risks backed by a well diversified portfolio than it would need to run the company with a single (very large) bond.

I can appreciate why discounting at risk-free rates is desirable for simplicity sake, but I think a strong case can be made for a higher rate. As described in the previous section, a bond's credit spread should reflect a spread higher than the best estimate of credit losses because the spread has to reward the risk taker for the capital he needs to post to manage these risks. As was discussed before, by diversifying default risk across a non-correlated portfolio of bonds, we reduce the required capital needed to manage the portfolio, and thus there should be extra spread (margin) available.

Incorporating Credit Worthiness in Discounting

I have encountered many people who feel very strongly that incorporating credit risk into the discounting of liability cash flows is just plain wrong. If we were discussing regulatory valuation, I would agree without reservation; however, since this is GAAP reporting I will admit to being able to see both sides.

On a theoretical level, incorporating an instrument's credit spread makes sense because it should reduce income volatility. An insurance enterprise that is managing risk prudently should invest the funds to back reserves in a diversified portfolio of fixed income assets that approximates the credit worthiness of the instrument being managed. That way, if there is a credit event or shock in the broader markets, credit spreads on the asset portfolio will decrease the value of those assets, but the credit worthiness of the instrument being valued should have widened as well, also reducing the fair value of the liability being valued. If management did a good job of matching, the decrease in assets should be offset by the decrease in liabilities. Without incorporating credit worthiness into the fair value of the liability, all credit events would produce income equal to the change in fair value of the assets. So on a theoretical level, this makes perfect sense: a well managed company should see earnings volatility if credit spreads widen a little.

On a practical level, it will be exceedingly difficult to monitor and estimate the credit worthiness of instruments each quarter. There is a very real possibility that methods for estimating credit worthiness will be somewhat arbitrary and will create artificial income volatility that could be worse than if no creditworthiness was considered. Here the actuary will need to remember that in predicting a price (not a probability of default), markets move together. A survey of the broader market might be the best method of estimating creditworthiness of the instrument.

Concluding Remarks

Obviously, the thoughts contained herein are in no way exhaustive on the subject, but it is my hope that actuaries will consider these issues I have raised. I think that if they do, a better understanding of the implications of the issues will lead them to develop better valuation methods for putting a fair value on insurance liabilities. $

Embedded Value Reporting Redux

Stop us if you've heard this one—Embedded value reporting is coming to North America. This has been heard in various forms since the late '90s. But this time it's true. Embedded value (EV) reporting is growing in importance in North America for several reasons. Most European insurance groups (and, by extension, their North American subsidiaries) are reporting embedded value results publicly. In Canada, two of the "Big Three" regularly disclose embedded values as part of their external reporting. The concept behind embedded value is similar in nature to the principles-based approaches being developed by the American Academy of Actuaries, and investment analysts and rating agencies are increasingly turning to economic measures of value other than traditional statutory or GAAP reporting.

One major criticism of embedded values has always been the lack of authoritative guidance. Because EV reporting lies outside the purview of statutory and GAAP accounting, North American standard setters have steered clear of addressing EV (notwithstanding a paper published by the Canadian Institute of Actuaries in 2000). However, with EV gaining popularity outside North America, in 2004 a group comprised of the CFOs of the major European life insurers published a set of principles for reporting embedded values. These principles, and subsequent releases, have begun to form a set of codified guidance for EV reporting that has, in part, filled that void for North American insurers.

With that in mind, the Academy's Life Financial Reporting Committee decided to further enhance the guidance available to actuaries performing EV work. The Committee is currently completing a Practice Note for North American actuaries on the reporting of embedded values. This work comes not a moment too soon. The SOA Embedded Value Webcast was attended by at least 600 people, indicating that interest in EV reporting is on the upswing, with more than half of registrants stating they were currently calculating EV in some form.

The Practice Note focuses on traditional and European Embedded Values, while leaving the thornier issues relating to Market-Consistent Embedded Values for a future Note. Topics covered include:

- Introduction to embedded values
- Mechanics of embedded values
- Non-economic assumptions
- Economic assumptions
- Analysis of movement
- Treatment of options and guarantees
- Disclosure of embedded values

As is characteristic of Academy Practice Notes, the focus is on the current state of practice in North America, although the Committee does attempt to provide some of the theoretical basis underlying certain issues. The target date for the release of the exposure draft is December 2007.

Many thanks to Tina Getachew, Academy Risk Management and Financial Reporting Policy Analyst and the following Committee members and other volunteers who have devoted time and energy to the development of this new Practice Note:

- Errol Cramer
- Rob Frasca
- Noel Harewood
- Ken LaSorella
- Patricia Matson
- James Norman
- Jack Walton
- Darin Zimmerman

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The Lowly Loss Ratio

by Paul Margus

"There are more things in heaven and earth, Loss Ratio, than are dreamt of in your philosophy."

The loss ratio has been around for a long time. A properly formulated loss ratio tells us what portion of premium income is set aside for claims, over a fairly short interval, over many years, or over the lifetime of an entire block. Yet despite its many modifications to accommodate diverse lines of business, it's still a very blunt instrument.

Loss ratios began as a casualty insurance concept. In auto and homeowners' insurance, renewal periods are short. The loss ratio is just the aggregate claims paid, divided by the aggregate premiums collected. This works because the premiums and claims are confined to a short period, usually one year or less. The timing of the premiums collected roughly matches the timing of the cash claim payouts.

Subsequently, the loss ratio was embraced by the group and individual health insurance business. In those lines, claims can extend much longer, necessitating long-tail claim reserves and the "incurred claims" concept.

With Long Term Care and Individual Disability Income things get more complicated. These lines use issue age and level premiums, an idea borrowed from life insurance. Active life reserves and investment income complicate the picture, requiring further refinements, and recognition of the time value of money. Here, our definition is more properly the *present value* of (expected) future claims, divided by present value of future premiums. Or equivalently, it's the *accumulated value* of (actual) past claims, divided by the accumulated value of past premiums. Despite all those elaborations, loss ratio calculations are based solely on aggregate data and are easy to calculate.

As we will see, these last enhancements have, by necessity, made the loss ratio sensitive to policy persistency. Thus, it's no longer a pure measurement of claims.

The loss ratio is often used for regulatory purposes. For new rate filings in some lines, companies must demonstrate that the loss ratio, calculated under reasonable assumptions, is expected to meet a legal minimum. In addition, they must monitor emerging experience on their existing business in force. If claims are lower than expected, they may have to decrease premiums or increase policyholder dividends. But this article will concentrate on using the loss ratio as an internal management tool. The methods analyzed here may not precisely match the legal definitions.

What makes a good tool for financial analysis?

- Ease of use—The traditional loss ratio is easy to calculate, because it's based solely on aggregate data, namely premiums, claims and reserves. If possible, any refinement should preserve this advantage. But, as we'll see below, we must sacrifice some simplicity to understand loss ratio dynamics and tie it into other financial measures.
- Drill-down capability—If we subdivide our data, it should be possible to get loss ratios for various underwriting and occupation classes, geographical regions and markets. This can help us monitor the experience of important subgroups, and estimate our pricing adequacy.
- Consistency—To be useful, a measurement must be consistent. Having adopted a benchmark, we should be able to judge how we're doing in relation to it. In other words, if our experience is exactly as originally assumed, the loss ratio should remain constant throughout the life of the business.

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… loss ratio calculations are based solely on aggregate data and are easy to calculate.

The remainder of this article will explore alternative definitions and their mathematical underpinnings. We'll discuss the modifications for level premium lines of business, chiefly Long Term Care and Individual Disability Income, harping again and again on the importance of interest adjustments. The loss ratio concept will be extended to expenses and profit. Limited pay plans and Life Insurance will be briefly explored. Finally, we'll examine the strengths and limitations of the loss ratio, and how they can be remedied. This will entail linking the loss ratio to gain and loss analysis.

In the next two sections, we deal separately with numerator and denominator.

The Numerator: Claims

For very short-duration claims, it may be sufficient simply to use cash payments. But if claim payouts extend beyond the expected period of the loss ratio, we will have to include the claim reserve. We have two methods of addressing this.

1. The simpler method is to include the *initial claim reserve at the moment of inception,* and ignore all subsequent activity on that claim. For our loss ratio, the entire claim obligation is discharged in one lump sum. Thus, the loss ratio responds to actual claim incidence, but not to deviations from our assumed claim termination.

2. Another method is to count *cash payouts, plus the increase in claim reserve.*

Initially, Method 2 is equivalent to the Method 1. At claim inception, the claim reserve *instantaneously* jumps from zero to its initial value. And in this infinitesimal span, we haven't had enough time to make any payment. But subsequently, Method 2 makes mid-course corrections as the actual claim terminations deviate from expected. To see this, consider the familiar recursive formula for the annuity function.

Equation 1

$$\left(1-h_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x]+t} = \left(1+i_t\right) \times \left(\ddot{a}^{(i)}_{[x]+t-1} - 1\right)$$

Here, $\ddot{a}^{(i)}_{[x]+t}$ is the claim reserve, $h_{[x]+t-1}$ is the claim termination rate expected in the claim reserve calculation, i_t is the reserve interest rate, and the periodic claim payout is \$1.

Actual claim termination always differs from expected. Let the actual termination rate during claim year t be $\hat{h}_{[x]+t-1}$. Then, subtracting $\left(\hat{h}_{[x]+t-1} - h_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x]+t}$ from both sides of Equation 1, we get

Equation 2

$$\left(1-\hat{h}_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x]+t} = \left(1+i_t\right) \times \left(\ddot{a}^{(i)}_{[x]+t-1} - 1\right) - \left(\hat{h}_{[x]+t-1} - h_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x]+t}$$

At the beginning of the period, the aggregate inforce is \$1 and the aggregate claim reserve is $(1) \times \left(\ddot{a}^{(i)}_{[x]+t-1}\right)$. At the end of the period, we're left with $\left(1-\hat{h}_{[x]+t-1}\right)$ of aggregate claims in force, bearing an aggregate reserve of $\left(1-\hat{h}_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x]+t}$.

$\left(\hat{h}_{[x]+t-1} - h_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x]+t}$ is the amount of "actuarial gain from claim termination." If aggregate claims in the period are exactly as expected, then the actuarial gain is zero. If terminations are bigger than expected, the gain is positive. If they're less than expected, the gain is negative, and we have a loss from claim termination.

Thus, on any closed block of claims, we can subtract actual claim payouts from the last period's aggregate claim reserve. Then we adjust for interest, taking into account the actual timings. If this overstates the current aggregate claim reserve, then the amount of the overstatement represents the actuarial gains for the period.

So, in many practical applications, $\left(\hat{h}_{[x]+t-1} - h_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x]+t}$ is just the balancing item. But as I will explain later, it may be useful to invest additional effort to calculate it explicitly.

For other than annual payouts with one-year loss ratios, the above math is more complex; but the result is the same, as long as we let our interest adjustments reflect the actual timing of the payments.

We now return to our definition of "incurred claims": cash payouts, plus the increase in claim reserve.

Equation 3

$$\begin{pmatrix} \textit{Incurred} \\ \textit{Claims} \end{pmatrix} = \begin{pmatrix} \textit{Cash} \\ \textit{Payouts} \end{pmatrix} + \begin{pmatrix} \textit{Increase in} \\ \textit{Claim Reserve} \end{pmatrix}$$

$$= \{(1)\} + \left\{ \frac{\left(1 - \hat{h}_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x]+t}}{1 + i_t} - \left(\ddot{a}^{(i)}_{[x]+t-1}\right) \right\}$$

To make things work out neatly in Equation 4, I have applied an interest adjustment to the reserve increase in Equation 3. In the real world, the claim payout isn't concentrated at the beginning, so it may need some sort of discounting, too. In practice, that's all there is to calculating the aggregate incurred claims. But let's see what we're actually calculating.

Equation 4

$$\begin{pmatrix} Incurred \\ Claims \end{pmatrix} = \{(1)\} + \left\{ \frac{\left(1 - \hat{h}_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x]+t}}{1 + i_t} - \left(\ddot{a}^{(i)}_{[x]+t-1}\right) \right\}$$

$$= \frac{\left(1 - \hat{h}_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x]+t}}{1 + i_t} - \left(\ddot{a}^{(i)}_{[x]+t-1} - 1\right)$$

$$= \frac{\left(1 - \hat{h}_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x]+t} - \left(1 + i_t\right) \times \left(\ddot{a}^{(i)}_{[x]+t-1} - 1\right)}{1 + i_t}$$

$$= -\frac{\left(\hat{h}_{[x]+t-1} - h_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x]+t}}{1 + i_t}$$

$$= -\begin{pmatrix} Discounted \\ Actuarial \\ Gains \end{pmatrix}$$

As mentioned above, at the moment of claim inception, Method 2 is identical to Method 1. Thereafter, Method 2 records deviations from expected terminations as actuarial gains. These gains (and losses) serve as mid-course corrections to the initial claim reserve, which occur only as the experience unfolds.

Method 1 is simpler, and it confines the claim experience to the period of the loss ratio, while neglecting the mid-course corrections. Method 2 scrupulously adjusts for under- or over-reserving over time. But it blends prior claims into the calculation of the current loss ratio. Thus, each method has its advantages and disadvantages.

In the above derivations, we have assumed that our claim reserve is a quasi life annuity calculation. But these principles are equally valid for claim triangles. In any event, if claim durations are potentially long, we need an interest element in the reserve and incurred claim calculations. (Loss reserves should be discounted.)

As a practical matter, under Method 2, the incurred claims are calculated using the fundamental definition: cash payouts, plus the (interest-adjusted) increase in claim reserve. The sole purpose of our derivations was to show that incurred claims are exactly:

- the claim reserve at the moment of claim inception, and
- the negative of actuarial gains for any subsequent period.

The Denominator: Premiums

Premiums should be recognized only when due. "Incurred Premiums" represent what we'll collect over the period, if everyone pays exactly on time. This is just the Cash Collections over the period, plus the increase in "Premiums Due and Unpaid," minus the increase in "Premiums Paid in Advance."

Equation 5

$$\begin{Bmatrix} Incurred \\ Premiums \end{Bmatrix} = \begin{Bmatrix} Cash \\ Premiums \end{Bmatrix} + \left(\begin{Bmatrix} Due\ \& \\ Unpaid \end{Bmatrix}_1 - \begin{Bmatrix} Due\ \& \\ Unpaid \end{Bmatrix}_0 \right) - \left(\begin{Bmatrix} Ad- \\ vance \end{Bmatrix}_1 - \begin{Bmatrix} Ad- \\ vance \end{Bmatrix}_0 \right)$$

A further refinement is to use the "Earned Premium," which represents what we would collect if premiums were paid continuously, and always exactly on time. Thus, over a four-month period, we show $\frac{4}{12}$ of an annual premium, regardless of when the policy anniversary occurs. (Otherwise, for a block of policies paying annually in February, we could be dividing by zero if we tried to do a loss ratio for just the summer months. And a first quarter loss ratio would be understated because it would reflect a whole year's premium.) The "earned premium" is the "incurred premium," minus the increase in unearned premiums.

Equation 6

$$\begin{Bmatrix} Earned \\ Premiums \end{Bmatrix} = \begin{Bmatrix} Incurred \\ Premiums \end{Bmatrix} - \left(\begin{Bmatrix} Un- \\ earned \end{Bmatrix}_1 - \begin{Bmatrix} Un- \\ earned \end{Bmatrix}_0 \right)$$

For loss ratios taken over an extended period, we must adjust for interest. This means taking the present or accumulated value of premiums. In addition, it seems appropriate to interest-adjust all of the "Due and Unpaid," "Advance" and "Unearned" accruals. (See the Active Life Reserves section)

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Active Life Reserves

The above formulation is consistent with a mid-terminal Active Life Reserve. If t represents the time (in years) since the last anniversary (between 0 and 1), then it's good enough to interpolate the Active Life Reserve linearly between anniversaries:

Equation 7

$$ALR_t = (1-t) \times ALR_0 + (t) \times ALR_1$$

This differs somewhat from custom as follows:

- The unearned premium is *omitted* from the reserve;
- In Equation 6 above, we *subtracted* it from the premiums.

If our reported premiums and reserves follow a different convention, we should adjust them for loss ratio calculations. (In the case of Life Insurance, premiums should exclude any increase in deferred premium. For the casualty and group lines, we end up with no active life reserve at all.)

To get meaningful loss ratios, we'll want our reserves to be as realistic as possible. Usually, GAAP benefit reserves are the best candidate. To the extent possible, the margins for adverse deviation should be removed, perhaps using a simple multiple.

Long Term Care and Individual Disability Insurance specify level premiums, payable for the term of the coverage or for a limited period. Because the premium is level and claim costs are increasing, the premiums and claim costs are mismatched. Without some adjustment for active life reserves, the loss ratios will be meaningless. They will start out unrealistically low, but would ultimately attain astronomical levels. To remedy this, we recognize the increase in active life reserves as part of the claim cost for the current period. Two definitions are popular.

Equation 8

$$\begin{pmatrix} Loss \\ Ratio \end{pmatrix} = \frac{Claims + [ALR_1 - ALR_0]}{Earned \quad Premiums}$$

Equation 9

$$\begin{pmatrix} Loss \\ Ratio \end{pmatrix} = \frac{Claims + \left[\frac{1}{1+i} \times ALR_1 - ALR_0\right]}{Earned \quad Premiums}$$

As always, the 0 subscript refers to the beginning of the period, while 1 means the end.

Equation 9 is the better choice. As we will show in section entitled Doing the Math, the loss ratio works out to be the valuation net premium for the benefit reserve, divided by the gross premium, minus actuarial gains (as a percent of premium). Thus, it meets the "consistency" criterion discussed in the introduction of this article.

If you accept the previous assertion for now, then Equation 8 fails the "consistency" criterion. Even in the absence of actuarial gains, the loss ratio won't be level. In the early policy years, when the active life reserve is small, it will be almost right. It will increase artificially as the missing interest adjustment becomes significant. It will peak at some point, and then decrease back to normal at the end of time. Back in the real world, when the loss ratio increases, we won't know whether to blame bad claims or chalk it up to the natural behavior of an aging block.

Over an extended period, Equation 9 is better written as:

Equation 10

$$\begin{pmatrix} Loss \\ Ratio \end{pmatrix} = \frac{PV\begin{pmatrix} Incurred \\ Claims \end{pmatrix} + PV\begin{pmatrix} Int - Adj \\ Incr \quad in \\ ALR \end{pmatrix}}{PV\begin{pmatrix} Earned \\ Premiums \end{pmatrix}}$$

where *PV(whatever)* is the n-year present value at the mth policy year, or

$$\sum_{t=0}^{n-1} v^t \, {}_t\hat{p}_{[x]+m} \times whatever_{[x]+m+t}$$

Now, we define a few symbols.

x = Issue Age.

t = Policy Year.

${}_tV_x$ = Active life reserve per unit in force at the end of policy year *t*.

${}_0V_x$ = Active life reserve on the policy issue date, which is zero.

${}_nV_x$ = Active life reserve at the end of coverage. P_x is chosen so that this comes out to zero.

i_t = Valuation interest rate for policy year t.

$\hat{w}_{[x]+t-1}$	=	Actual Lapse rate for policy year t.
$\hat{q}_{[x]+t-1}$	=	Actual Mortality rate for policy year t.
\$1	=	Actual Amount in force at *beginning* of policy year t.
$1-\hat{w}_{[x]+t-1}-\hat{q}_{[x]+t-1}$	=	Actual Amount in force at the *end* of policy year t.
$1.0000 \times {}_{t-1}V_x$	=	Aggregate Reserve at *beginning* of policy year t.
$\left(1-\hat{w}_{[x]+t-1}-\hat{q}_{[x]+t-1}\right) \times {}_tV_x$	=	Actual Aggregate Reserve at *end* of policy year t.

Therefore,

$$PV\begin{pmatrix} Int-Adj \\ Incr \quad in \\ ALR \end{pmatrix} = \sum_{t=0}^{n-1} v^t \, {}_t\hat{p}_{[x]+m} \times \left\{ \frac{1}{1+i} \times ALR_1 - ALR_0 \right\}$$

$$= \sum_{t=0}^{n-1} v^t \, {}_t\hat{p}_{[x]+m} \times \left\{ \frac{\left(1-\hat{w}_{[x]+m+t}-\hat{q}_{[x]+m+t}\right)\times {}_{m+t+1}V_x}{1+i} - (1)\times {}_{m+t}V_x \right\}$$

$$= \sum_{t=0}^{n-1} v^{t+1} \, {}_{t+1}\hat{p}_{[x]+m} \times {}_{m+t+1}V_x - \sum_{t=0}^{n-1} v^t \, {}_t\hat{p}_{[x]+m} \times {}_{m+t}V_x$$

$$= \sum_{t=1}^{n} v^t \, {}_t\hat{p}_{[x]+m} \times {}_{m+t}V_x - \sum_{t=0}^{n-1} v^t \, {}_t\hat{p}_{[x]+m} \times {}_{m+t}V_x$$

$$= v^n \, {}_n\hat{p}_{[x]+m} \times {}_{m+n}V_x - v^0 \, {}_0\hat{p}_{[x]+m} \times {}_{m+0}V_x$$

$$= \frac{{}_n\hat{p}_{[x]+m} \times {}_{m+n}V_x}{(1+i)^n} - {}_mV_x$$

At policy year m, we have \$1 in force with an aggregate reserve of ${}_{m+n}V_x$. Then n years later, ${}_n\hat{p}_{[x]+m}$ remains in force, and the aggregate reserve is ${}_n\hat{p}_{[x]+m} \times {}_{m+n}V_x$.

Substituting into Equation 10, we get

Equation 11

$$\begin{pmatrix} Loss \\ Ratio \end{pmatrix} = \frac{PV\begin{pmatrix} Incurred \\ Claims \end{pmatrix} + \left(\frac{{}_n\hat{p}_{[x]+m} \times {}_{m+n}V_x}{(1+i)^n} - {}_mV_x \right)}{PV\begin{pmatrix} Earned \\ Premiums \end{pmatrix}},$$

which looks a lot like Equation 9. From this, we draw some conclusions.

- Equation 9 applies over any period of time that we choose, as long as we properly adjust for interest.
- The foregoing derivation does not in any way use the reserve valuation assumptions. But the section Doing the Math does.
- Reserves matter only at the endpoints. Intermediate reserves have no effect on the loss ratio.
  - o Within the $PV\begin{pmatrix} Incurred \\ Claims \end{pmatrix}$ term, the claim reserve increases (Method 2) telescope in the same way.
  - o For m = 0 (new business) and $n=\infty$ (the end of time), the reserve increase becomes Zero minus Zero. Similarly, the accruals in Equation 5 and Equation 6 go to zero, so the lifetime loss ratio is

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Equation 12

$$\begin{pmatrix} Loss \\ Ratio \end{pmatrix} = \frac{PV\begin{pmatrix} Cash \\ Claims \end{pmatrix}}{PV\begin{pmatrix} Cash \\ Premiums \end{pmatrix}},$$

which is similar to the loss ratio that we file for a new policy form.

- o As mentioned previously, the premium accruals need interest adjustments of the form

$$\frac{\{Due \,\&\, Unpaid\}_{m+n}}{(1+i)^n} - \{Due \,\&\, Unpaid\}_m$$

$$\frac{\{Advance\}_{m+n}}{(1+i)^n} - \{Advance\}_m$$

$$\frac{\{Unearned\}_{m+n}}{(1+i)^n} - \{Unearned\}_m$$

- For analyzing past results, we calculate retrospective accumulated values rather than present values. Instead of inserting persistency and mortality assumptions into the Equation 11 summations, we simply accumulate aggregate the historical premiums and claims with interest. At the endpoints, we use actual reserves with the interest adjustment.

Doing the Math

The active life reserve funds benefits over the term of the coverage. During policy year t, it changes as follows:

Equation 13

$$\left(1 - w_{[x]+t-1} - q_{[x]+t-1}\right) \times {}_tV_x$$

$$= \left(1+i_t\right) \times \left({}_{t-1}V_x + P_x\right) - r_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]}$$

where

P_x = Net level premium.

$r_{[x]+t-1}$ = Valuation Claim incidence rate for policy year t.

$\ddot{a}^{(i)}_{[x+t]}$ = The present value of benefits at inception, under a claim starting in policy year t. For individual disability income, it's the familiar claim annuity.

$r_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]}$ = The net annual claim cost for claims starting in policy year t.

$w_{[x]+t-1}$ = Valuation Lapse rate for policy year t.

$q_{[x]+t-1}$ = Valuation Mortality rate for policy year t.

Here, the net level premium is set at a level that funds the benefits over the term of the policy, assuming that claim costs, interest, lapse and mortality occur exactly as assumed. Thus, the Active life reserve starts and ends at zero. At intermediate times, if $r_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]}$ generally increases with t, the reserve is greater than zero.

Actual Experience never follows our script.

$\hat{r}_{[x]+t-1}$ = Actual Claim incidence rate for policy year t.

$\hat{r}_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]}$ = The actual net annual claim cost for claims starting in policy year t. To keep it simple, I'm using the Method 1 definition of "incurred claims."

If 1.0000 = Amount in force at the beginning of policy year t, then;

$\left(1 - w_{[x]+t-1} - q_{[x]+t-1}\right) \times {}_tV_x$ = Expected Aggregate Reserve at end of policy year t.

$1 - w_{[x]+t-1} - q_{[x]+t-1}$ = Expected Amount in force at the end of policy year t.

Then, we can transform Equation 13 as follows:

$$\left(1 - w_{[x]+t-1} - q_{[x]+t-1}\right) \times {}_tV_x =$$
$$\left(1+i_t\right) \times \left({}_{t-1}V_x + P_x\right) - r_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]}$$

Add $\left(w_{[x]+t-1} + q_{[x]+t-1}\right) \times {}_tV_x$ (expected decrements) to both sides …

$${}_tV = \left(1+i_t\right) \times \left({}_{t-1}V_x + P_x\right) - r_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]}$$
$$+ w_{[x]+t-1} \times {}_tV_x + q_{[x]+t-1} \times {}_tV_x$$

Subtract $\left(\hat{w}_{[x]+t-1} + \hat{q}_{[x]+t-1}\right) \times {}_tV_x$ (actual decrements) from both sides …

$$\left(1 - \hat{w}_{[x]+t-1} - \hat{q}_{[x]+t-1}\right) \times {}_tV_x = \left(1+i_t\right) \times \left({}_{t-1}V_x + P_x\right) - r_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]}$$
$$+ w_{[x]+t-1} \times {}_tV_x + q_{[x]+t-1} \times {}_tV_x$$
$$- \hat{w}_{[x]+t-1} \times {}_tV_x - \hat{q}_{[x]+t-1} \times {}_tV_x$$

Collect terms …

$$= \left(1+i_t\right) \times \left({}_{t-1}V_x + P_x\right) - r_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]} - \left(\hat{w}_{[x]+t-1} - w_{[x]+t-1}\right) \times {}_tV_x - \left(\hat{q}_{[x]+t-1} - q_{[x]+t-1}\right) \times {}_tV_x$$

On the right hand side, add and subtract $\hat{r}_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]}$ (actual claims) …

$$= \left(1+i_t\right) \times \left({}_{t-1}V_x + P_x\right) - \hat{r}_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]} - \left\{ \begin{array}{l} \left(r_{[x]+t-1} - \hat{r}_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x+t]} \\ + \left(\hat{w}_{[x]+t-1} - w_{[x]+t-1}\right) \times {}_tV_x \\ + \left(\hat{q}_{[x]+t-1} - q_{[x]+t-1}\right) \times {}_tV_x \end{array} \right\}$$

Finally, we can write

Equation 14

$$\left(1 - \hat{w}_{[x]+t-1} - \hat{q}_{[x]+t-1}\right) \times {}_tV_x - \left(1+i_t\right) \times {}_{t-1}V_x = \left(1+i_t\right) \times P_x - \hat{r}_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]} - \left\{ \begin{array}{l} \left(r_{[x]+t-1} - \hat{r}_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x+t]} \\ + \left(\hat{w}_{[x]+t-1} - w_{[x]+t-1}\right) \times {}_tV_x \\ + \left(\hat{q}_{[x]+t-1} - q_{[x]+t-1}\right) \times {}_tV_x \end{array} \right\}$$

Equation 14 says

$$\left\{ \begin{array}{c} Interest\text{–}Adjusted \\ Reserve \\ Increase \end{array} \right\} = \left\{ \begin{array}{c} Interest\text{–}Adjusted \\ Earned \\ Net\ \ Premiums \end{array} \right\} - \left\{ \begin{array}{c} Actual \\ Claims \end{array} \right\} - \left\{ \begin{array}{c} Actuarial \\ Gains\ \ during \\ the\ \ period \end{array} \right\}$$

The actuarial gains represent deviations from expected claims, lapses and mortality. They can be either positive (favorable) or negative (unfavorable).

This motivates a definition for Interest-Adjusted Loss Ratio:

Equation 15

$$LR = \frac{\left\{ \begin{array}{c} Actual \\ Claims \end{array} \right\} + \left\{ \begin{array}{c} Interest\text{–}Adjusted \\ Reserve\ \ Increase \end{array} \right\}}{\left\{ \begin{array}{c} Interest\text{–}Adjusted \\ Earned\ \ Gross\ \ Premiums \end{array} \right\}}$$

$$= \frac{\left\{\hat{r}_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]}\right\} + \left\{\left(1 - \hat{w}_{[x]+t-1} - \hat{q}_{[x]+t-1}\right) \times {}_tV_x - \left(1+i_t\right) \times {}_{t-1}V_x\right\}}{\left(1+i_t\right) \times G_x} \quad \textbf{Equation 15}$$

$$= \frac{\left\{\hat{r}_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]} \hat{r}_{[x]+t-1}\right\} + \left\{\left(1+i_t\right) \times P_x - \hat{r}_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]} - \left(\begin{array}{l} \left(r_{[x]+t-1} - \hat{r}_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x+t]} \\ + \left(\hat{w}_{[x]+t-1} - w_{[x]+t-1}\right) \times {}_tV_x \\ + \left(\hat{q}_{[x]+t-1} - q_{[x]+t-1}\right) \times {}_tV_x \end{array} \right) \right\}}{\left(1+i_t\right) \times G_x}$$

Equation 16

$$= \frac{P_x}{G_x} - \frac{\left(r_{[x]+t-1} - \hat{r}_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x+t]} + \left(\hat{w}_{[x]+t-1} - w_{[x]+t-1}\right) \times {}_tV_x + \left(\hat{q}_{[x]+t-1} - q_{[x]+t-1}\right) \times {}_tV_x}{\left(1+i_t\right) \times G_x}$$

$$= \left\{ \begin{array}{c} Net\text{–}to\text{–}Gross \\ Ratio \end{array} \right\} - \frac{\left\{ \begin{array}{c} Actuarial\ \ Gains \\ during\ \ the\ \ period \end{array} \right\}}{\left\{ \begin{array}{c} Interest\text{–}Adjusted \\ Earned\ \ Gross\ \ Premiums \end{array} \right\}}$$

In practice, the loss ratio is calculated from aggregated data. Therefore, actual calculations use the Equation 15 definition. Equation 16 shows that the loss ratio is our established Net-to-Gross ratio, adjusted for experience over the period.

Expense Ratios, Combined Ratios and Profit Margin

In GAAP accounting, we establish a deferred acquisition cost asset. The DAC asset is simply the negative of an "expense reserve." From year to year, the expense reserve progresses in a manner similar to Equation 13:

Equation 17

$$\left(1 - w_{[x]+t-1} - q_{[x]+t-1}\right) \times {}_tV^{(e)}_x = \left(1+i_t\right) \times \left({}_{t-1}V^{(e)}_x + P^{(e)}_x - e_t\right),$$

where

e_t = Expected incurred expense at the beginning of policy year *t*.

$\hat{e}_t$ = Actual incurred expense at the beginning of policy year *t*.

$P^{(e)}_x$ = Expense Net level premium.

${}_tV^{(e)}_x$ = Expense Reserve per unit in force at the end of policy year *t*. It's generally negative. Negating it gives us the positive DAC asset.

Then we define an expense ratio as follows:

Equation 18

$$LR^{(e)} = \frac{\left\{ \begin{array}{c} Actual \\ Expenses \end{array} \right\} + \left\{ \begin{array}{c} Interest\text{–}Adjusted \\ Expense\ \ Reserve\ \ Increase \end{array} \right\}}{\left\{ \begin{array}{c} Interest\text{–}Adjusted \\ Incurred\ \ Gross\ \ Premiums \end{array} \right\}}$$

Skipping a lot of math that's very similar to our transformation of Equation 13, we get:

Equation 19

$$= \frac{P^{(e)}_x}{G_x} - \frac{\left(1+i_t\right) \times \left(e_t - \hat{e}_t\right) + \left(\hat{w}_{[x]+t-1} - w_{[x]+t-1}\right) \times {}_tV^{(e)}_x + \left(\hat{q}_{[x]+t-1} - q_{[x]+t-1}\right) \times {}_tV^{(e)}_x}{\left(1+i_t\right) \times G_x}$$

$$= \left\{ \begin{array}{c} GAAP \\ Amortization \\ \% \end{array} \right\} - \frac{\left\{ \begin{array}{c} Actuarial\ \ Expense\ \ Gains \\ during\ \ the\ \ period \end{array} \right\}}{\left\{ \begin{array}{c} Interest\text{–}Adjusted \\ Incurred\ \ Gross\ \ Premiums \end{array} \right\}}$$

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Actual calculations use the Equation 18 definition. Equation 19 shows that it works out to our GAAP amortization percentage, adjusted for experience over the period.

Equation 19 is the deferrable expense analogue of Equation 16. Adding:

- the net-to gross ratio from Equation 16 (covering benefits),
- the GAAP Amortization percentage from Equation 19, and
- some provision for nondeferrable expenses results in the "combined ratio," another concept borrowed from casualty insurance. And 100 percent minus the combined ratio is the profit margin.

Lines of Business

The Equation 9 definition of the loss ratio modifies the basic concept to fit issue age level premium plans, chiefly Long Term Care and Individual Disability Income.

In the early years, LTC claims are very small. Even significant percentage deviations will not register significantly in the loss ratio calculation. The actuarial gains from claim experience are small compared to the other components (Net-to-gross ratio, and mortality and lapse gains). High early lapses could make a new block of LTC look very profitable. But the remaining insureds may be less healthy, and subsequent claim experience may be unfavorable. You should always examine your loss ratio results critically, and understand what's driving them.

Limited-pay plans (e.g., 10-pay) present special problems. Applying our usual formulas, we're dividing by a very large premium in the early years. Later on, we're faced with the prospect of dividing by zero. None of this matters if we don't have much limited pay in force, or if we have a mature distribution by policy year. But the scheme is fairly popular; and most policies are probably still in their premium-paying period. One solution may be to restate the active-life reserve as lifetime pay, and treat the excess as unearned premium. Thus:

- the interest-adjusted increase in the lifetime pay portion would be added to claims in the numerator, and
- the increase in the interest-adjusted excess would be subtracted from the premiums in the denominator.

This doesn't sound very practical. If the limited-pay block is small, you can spare yourself the effort.

Equation 20

$$LR = \frac{P_x}{G_x} - \frac{\left(q_{[x]+t-1} - \hat{q}_{[x]+t-1}\right)\times\left({}_tF - {}_tV_x\right) + \left(w_{[x]+t-1} - \hat{w}_{[x]+t-1}\right)\times\left({}_tCV - {}_tV_x\right)}{\left(1+i_t\right)\times G_x},$$

We can apply these concepts to life insurance. The life insurance analog of Equation 16 is

where

$_tF$ = Face Amount for policy year t

$_tCV$ = Cash Value for policy year t (usually zero for term insurance)

In life insurance the law doesn't require loss ratio calculations. There is no consensus on acceptable values, especially for Cash Value Whole Life, although they may be helpful for term insurance. They may also be useful if your parent company is a casualty insurer.

Limitations and Food for Thought

The loss ratio is easy to apply, based solely on aggregate premiums, claims and reserves. Using modern data warehouse technology, we can examine separate loss ratios for various underwriting and occupation classes, geographical regions and markets.

Of course, we must confine our examination to subsets that produce statistically significant results. That entails some combination of choosing sufficiently large subsets or sufficiently long study periods.

But Equation 16 indicates one obvious area where the information is incomplete. We see that the major component of the loss ratio is the ratio of valuation net premium to gross premium (and this ratio may be similar to what we originally filed with the states). In the loss ratio calculation, actuarial gains, expressed as a percentage of premium, are implicitly subtracted.

So, if our loss ratio is higher than expected, is it because of excess claim incidence or insufficient lapses? (And if we're using method 2 to calculate our incurred claims, are low claim terminations to blame?) Thus, the loss ratio alone gives us an incomplete picture.

The solution is to calculate the individual actuarial gains explicitly. For example, Equation 16 contains $\left(r_{[x]+t-1} - \hat{r}_{[x]+t-1}\right)\times\ddot{a}^{(i)}_{[x+t]}$, the gain from incidence. The

$\hat{r}_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]}$ component is the sum of all new claim reserves established during the period. And $r_{[x]+t-1} \times \ddot{a}^{(i)}_{[x+t]}$ requires doing a summation over all active lives in force. Once we get those figures, we can divide $\left(r_{[x]+t-1} - \hat{r}_{[x]+t-1}\right) \times \ddot{a}^{(i)}_{[x+t]}$ by the interest-adjusted earned premiums, giving us the gain from incidence as a percentage of premium.

Similar analysis gives us the remaining actuarial gains. Then, we can calculate the aggregate net-to-gross ratio, subtract the actuarial gains percentages, and hope that they add up to the aggregate loss ratio.

This is a bit tedious, because we are required to go beyond merely taking ratios of aggregate quantities. But our reward is that we can split our loss ratio into the expected net-to-gross value and all deviations from expected. For example, assume that we priced for a 55 percent loss ratio, which is the net-to-gross premium ratio. During the period, if incidence gains are +2 percent, lapse gains are -7 percent, and termination gains are +1 percent, then our total loss ratio is

$$55\% - (2\% - 7\% + 1\%) = 59\%$$

The loss ratio is higher than we priced for, and yet claim incidence and termination are fine. The problem is "insufficient" lapses.

We can perform similar analysis of expenses (see Section 6). Then the "deferrable" expense ratio will be the GAAP amortization ratio, minus the actuarial gains. Here, the "insufficient" lapses may translate into an actuarial gain, somewhat offsetting the disappointing loss ratio.

All of the foregoing, plus the nondeferrable expenses and profit margin, add up to 100 percent. The moral of the story is that not all deviations are created equal. A higher than expected loss ratio does indicate an unanticipated level of claim payout. But if it's solely because of low lapses, then our expense amortization offers some mitigation.

GAAP reserves generally include some margin for adverse deviation. As mentioned earlier, we can have a more meaningful exhibit of actuarial gains if we devise an adjustment that removes them.

If the net-to-gross ratio varies by issue age, sex, underwriting class, etc., then the aggregate net-to-gross will gradually shift with variations in lapses and mortality. This is another pitfall to examining loss ratios in isolation. We can overcome this by splitting the loss ratio into its basic net-to-gross ratio, minus actuarial gains. $

What's Outside

Health Watch

Health Section Newsletter, Sept. 2007
http://www.soa.org/library/newsletters/health-watch-newsletter/2007/september/hsn-0708.pdf

IASB Phase II Insurance Contracts Project: Implications for U.S. Health Insurers
by Rowen B. Bell
An article about how IASB Phase II may affect reporting for health insurance products.

Long-Term Care News, Aug. 2007
http://www.soa.org/library/newsletters/long-term-care/2007/august/ltc-0807.pdf

Random Variation in Claims Reserves
by James Berger
On the challenges of explaining changes in claims reserves.

Taxing Times

Taxation Section Newsletter, Sept. 2007
http://www.soa.org/library/newsletters/taxing-times/2007/september/ttn-0907.pdf

Tax Uncertainty Swirls Around Principles-Based Reserves
by Christian DesRochers
Highlights some potential issues for the effect on Federal Income Tax when a Principles-Based approach to reserves is adopted.

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