



THE FINANCIAL REPORTER

THE NEWSLETTER OF THE LIFE INSURANCE COMPANY FINANCIAL REPORTING SECTION

PUBLISHED IN SCHAUMBURG, IL BY THE SOCIETY OF ACTUARIES

The Art of Stochastic Simulation in the Financial Reporting World An Overview of Stochastic Simulation

by Ron Harasym

Editor's Note: The section's Statutory Issues List Serve or GAAP List Serve would be an appropriate forum for discussing concepts in this article.

It used to be that stochastic simulations were known purely for burning out computer hardware, taking hundreds of hours to generate results and providing answers that few people understood and even fewer liked. Now, given the direction of future regulations and accounting standards and the increased focus on reserves and capital, insurers (and actuaries) have an increasing need to build, apply and interpret stochastic models for many new purposes. For example, in December 2002, the AAA Life Capital Adequacy Subcommittee recommended C3 Phase II for required surplus on variable products with guarantees (GMDBs, GMIBs, GMABs). Insurers have already started to build or to extend their modeling capabilities to meet these demands. Counter-intuitively, it is the more practical aspects of a stochastic simulation that repeatedly require careful thought and consideration. It is often assumed that many of these practical problems are easy to solve. Unfortunately the opposite can be the case, resulting in unexpected obstacles that may be costly to rectify. The purpose of this article is to provide a high-level overview of a stochastic simulation from a practical perspective, as well as to briefly touch on some of the potential mine fields along the way.

A STOCHASTIC MODEL / SIMULATION – DEFINED

The word “stochastic,” courtesy of dictionary.com, is derived from the Greek word

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THE FINANCIAL REPORTER

Issue Number 54 • September 2003

Published by the Life Insurance Company
Financial Reporting Section
of the Society of Actuaries

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Schaumburg, IL 60173-2226

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This newsletter is free to section members. A subscription is \$15.00. Current-year issues are available from the communications department. Back issues of section newsletters have been placed in the SOA library and on the SOA Web site: (www.soa.org). Photocopies of back issues may be requested for a nominal fee.

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Articles Needed for the *Reporter*

Your ideas and contributions are a welcome addition to the content of this newsletter. All articles will include a byline to give you full credit for your effort. *The Financial Reporter* is pleased to publish articles in a second language if a translation is provided by the author. For those of you interested in working in further depth on *The Financial Reporter*, several associate editors are needed. For more information, please call Jerry Enoch, editor, at (765) 477-3220.

The Financial Reporter is published quarterly as follows:

Publication Date

February 2004
May 2004
August 2004

Submission Deadline

Friday, November 14, 2004
Friday, February 13, 2004
Monday, May 14, 2004

PREFERRED FORMAT

In order to efficiently handle files, please use the following format when submitting articles:

Please e-mail your articles as attachments in either MS Word (.doc) or Simple Text (.txt) files to the newsletter editor. We are able to convert most PC-compatible software packages. Headlines are typed upper and lower case. Please use a 12-point Times New Roman font for the body text. Carriage returns are put in only at the end of paragraphs. The right-hand margin is not justified. Author photos are accepted in .jpg format (300 dpi) to accompany their stories.

If you must submit articles in another manner, please call Joe Adduci, 847-706-3548, at the Society of Actuaries for help.

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Thank you for your help.



SOCIETY OF ACTUARIES

The Chairperson's Corner

Your Feedback

by John F. Bevacqua

In the last edition of *The Financial Reporter*, I announced that the section council was going to conduct an online survey of the section membership, so that the council can more effectively prioritize its efforts. The purpose of the survey was to present to the general membership a variety of suggestions that the council received during our hot breakfast in Boston at last year's annual meeting, and determine which to pursue. I am pleased to report that 482 members of the section responded to our online survey. This represents approximately 13 percent of the section membership—a very strong rate of response. The results of the survey appear in the table. (see table in appendix in the back of this issue).

The section council reviewed these results and discussed them during our last conference call on June 30, 2003. Interpreting responses is always a challenge; while certain conclusions can clearly be drawn, others are more difficult. Nevertheless, the section council observed the following:

- The average response to the various seminar proposals (3.60) was somewhat higher than average responses for webcasts (3.33) and research proposals (3.31). This appears to indicate a slight preference toward seminars.
 - There appears to be strong interest in areas relating to GAAP.
 - The highest scoring initiative was a seminar on financial projections, receiving an average score of 3.92, with approximately 70 percent of the respondents scoring this a four or a five.
 - The lowest scoring initiative was a proposed webcast on mergers and acquisitions, receiving an average score of 2.93, with only 28 percent of respondents scoring this a 4 or a 5.
- *Seminar on Financial Projections*: we are working with the SOA staff to identify an appropriate time and location for this seminar and are also working on developing an agenda.
 - *Implementing Actuarial Guidelines*: the council is in the process of determining how to structure a seminar on this topic. With approximately 40 different actuarial guidelines currently in effect, we will need to determine which should be emphasized.
 - *Webcasts*: the council is in the process of implementing quarterly "Current Event" webcasts that will be approximately 1.5 to two hours in length, covering a few selected topics. Given the interest in GAAP Issues and Regulatory Updates expressed in the survey responses, we will likely rotate between GAAP and statutory accounting issues.
 - *Advanced DAC Issues*: the council reviewed the syllabus of the advanced GAAP seminar and concluded that a separate seminar focusing exclusively on DAC would be worthwhile. We are in the process of outlining an agenda for a seminar on this subject.
 - *RFP on Financial Statement Disclosure Practices*: the council decided to take preliminary steps to issue a Request For Proposal (RFP) to perform research on the financial statement disclosure practices of life insurance companies. We are working with the SOA staff and appropriate practice areas to define areas of focus and develop an RFP.

When examining the survey responses, we found that 460 of the 482 respondents scored at least one of these five initiatives a 4 or a 5. Therefore, we are optimistic that the efforts of the council are well aligned with the interest of the section.

Thank you all for your participation in the survey—you have been heard! ☒

ACTIONS TO BE TAKEN

Based upon the feedback provided, the section council is pursuing the following initiatives:



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Letter From the Editor

New Production Schedule for *The Financial Reporter*

by Jerry Enoch

Production Month	Submission Deadline
November 2003	August 15, 2003
February 2004	November 14, 2003
May 2004	February 13, 2004
August 2004	May 14, 2004

One of the few things we can count on is that there will be change. Now, change is coming to the production schedule of *The Financial Reporter*. We have been publishing in March, June, September and December. Starting with the next issue, we will be publishing in February, May, August and November. Another change is that the Society is going to try to get section newsletters into the readers' hands earlier in the month of production—during the first week. Of course, if you're like me, you just read them when they come (or try to).

For a small minority of us, the authors, there is more involved in the change in production schedule. Authors need to know when their articles must be received by the editor to make the next issue.

Those look like long gaps. I promise, I have not increased the time allowed for editing!

One consequence of this change in production schedule is that the next issue will be published less than two months after this issue. I would be worried about a lack of articles, but I'm already aware of several good articles that should be ready in time. Of course, I'm hoping to get more.

I have been very excited about the number of good, unsolicited articles that have been submitted in recent months. It is clear that a lot is going on, that many of our members have topics they can write about, and they are doing it! Thank you so much! I hope that others will consider adding themselves to our group of authors. ☺

– Jerry



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Corrections to Article in the June Issue of *The Financial Reporter*

Thanks to the comments from interested readers of the article, "Purchase GAAP for Equity-Indexed Annuities," it was discovered that three formulae in the article contain minor errors. These errors do not affect the validity of the concepts presented in the article. The corrected formulae are listed below.

On page 14, the formulae for VOBA and DTL should be:

$$\text{VOBA} = \text{GAAPV} - \frac{[\text{Invested Assets} - P - \text{Tax Rate} * (\text{TaxV} - \text{DACTax})]}{(1 - \text{TaxRate})}$$

$$\text{DTL} = \frac{\text{TaxRate} * [(\text{TaxV} - \text{DACTax}) - \text{Invested Assets} + P]}{(1 - \text{TaxRate})}$$

On page 16, the formula for GAAPV should be:

$$\text{GAAPV} = \text{VOBA} + \frac{[\text{Invested Assets} - P - \text{Tax Rate} * (\text{TaxV} - \text{DACTax})]}{(1 - \text{TaxRate})}$$

We appreciate the readers' efforts for calling them to our attention. We sincerely hope to receive more comments from interested readers regarding this topic. Thank you for your comments and interest in this article.

Jerry Enoch

stokhastikos, which means, in short, “to guess at.” This, however, is a definition you may decide *not* to share with senior management when presenting stochastic simulation results. A stochastic model by definition has at least one random variable and deals with the behavior of modeled variables over time. Stochastic simulation uses a statistical sampling of multiple replicates (i.e., repeated simulations) of the same stochastic model. Such simulations are also sometimes referred to as Monte Carlo simulations because of their use of random variables.

STOCHASTIC SIMULATION – WHAT IT IS

A stochastic simulation is an imitation and simplification of a real world system—an imprecise technique that provides only statistical estimates and not exact results. Stochastic simulation serves as one of several tools in a company’s risk measurement toolkit that provides assistance in product design and pricing, forecasting, risk management and financial reporting. Simulations are used when the financial systems being modeled are too complex to be described by a set of mathematical equations for which a closed form analytic solution is readily attainable. Results tend to be presented in the form of distributions with various statistical measures, such as conditional tail expectations (CTEs), used to capture the information contained within. All in all, applied stochastic simulation is part art, part science, part judgment and part common sense.

... AND WHAT IT ISN’T

Stochastic simulation is not a magical solution! One needs to thoroughly understand all model limitations and constantly perform reality checks throughout the entire modeling process. In the case of stochastic simulation, the spirit of *caveat emptor* (buyer beware) certainly is applicable.

ADVANTAGES OF STOCHASTIC SIMULATION

The use of stochastic simulation techniques, aside from probably being mandated for

financial reporting requirements such as C3 Phase II for required surplus on variable products with guarantees, does have a number of advantages. For example:

- Complex systems with long time frames can be studied in compressed time.
- One is able to assist in decision making and to quantify the frequency and severity distributions of future outcomes arising from different actions/strategies before implementation.
- One can attempt to better understand properties of real world systems such as policyholder behavior.
- The benefit from natural risk diversification can be identified and quantified.

But perhaps most useful (and painful) of all, you can watch your company fail over and over again through simulation of those embedded liability options that many people originally deemed to be worthless!

LIMITATIONS OF STOCHASTIC SIMULATION

Stochastic simulation requires a considerable investment of time and expertise. The modeling concepts are technically challenging and computationally demanding. Often, reliance is placed (and companies become dependent) on a few “good” people. Other limitations of stochastic simulation are as follows:

- In order to limit the complexity of stochastic simulation, simplifications (or short cuts) often have to be made. Consequently, it may not be possible to include all future events in a model. One has to apply judgment and common sense as to what variable interactions are most pertinent.
- Results are highly sensitive to the estimation of model parameters and the identification of variable interactions.

continued on page 6

- Each scenario provides only an estimate (and not the exact result) of the real-world system.
- The use of thousands of scenarios may create a false set of precision, along with an artificial sense of confidence, while the real issue of accuracy is overlooked.
- Given the large volume of information that stochastic simulations typically generate, the end-results may be difficult to interpret, validate, and communicate.

Stochastic simulation is truly a situation where the “Garbage in, garbage out!” rule applies.

WHEN IS STOCHASTIC SIMULATION PREFERRED?

Stochastic simulation is preferred over deterministic modeling when:

- Dealing with skewed risk distributions or discontinuous cost functions.
- There is significant volatility in the underlying variables.
- Modeling multiple risks that are not independent.
- Risk is path dependent.
- Volatility or skewness of underlying variables is likely to change over time.
- You want to model “tail” or extreme events.
- Regulations provide real economic incentives, such as material reserve or capital relief, to perform stochastic simulation.

As examples of the latter, proposed changes to U.S. GAAP reserving for GMDB and GMIB benefits promote the use of stochastic approaches. In Canada, the use of one’s own stochastic models provide some reserve and statutory capital (MCCSR) relief for investment guarantees provided to policyholders on segregated (separate account) funds.

A GENERIC STOCHASTIC SIMULATION FRAMEWORK

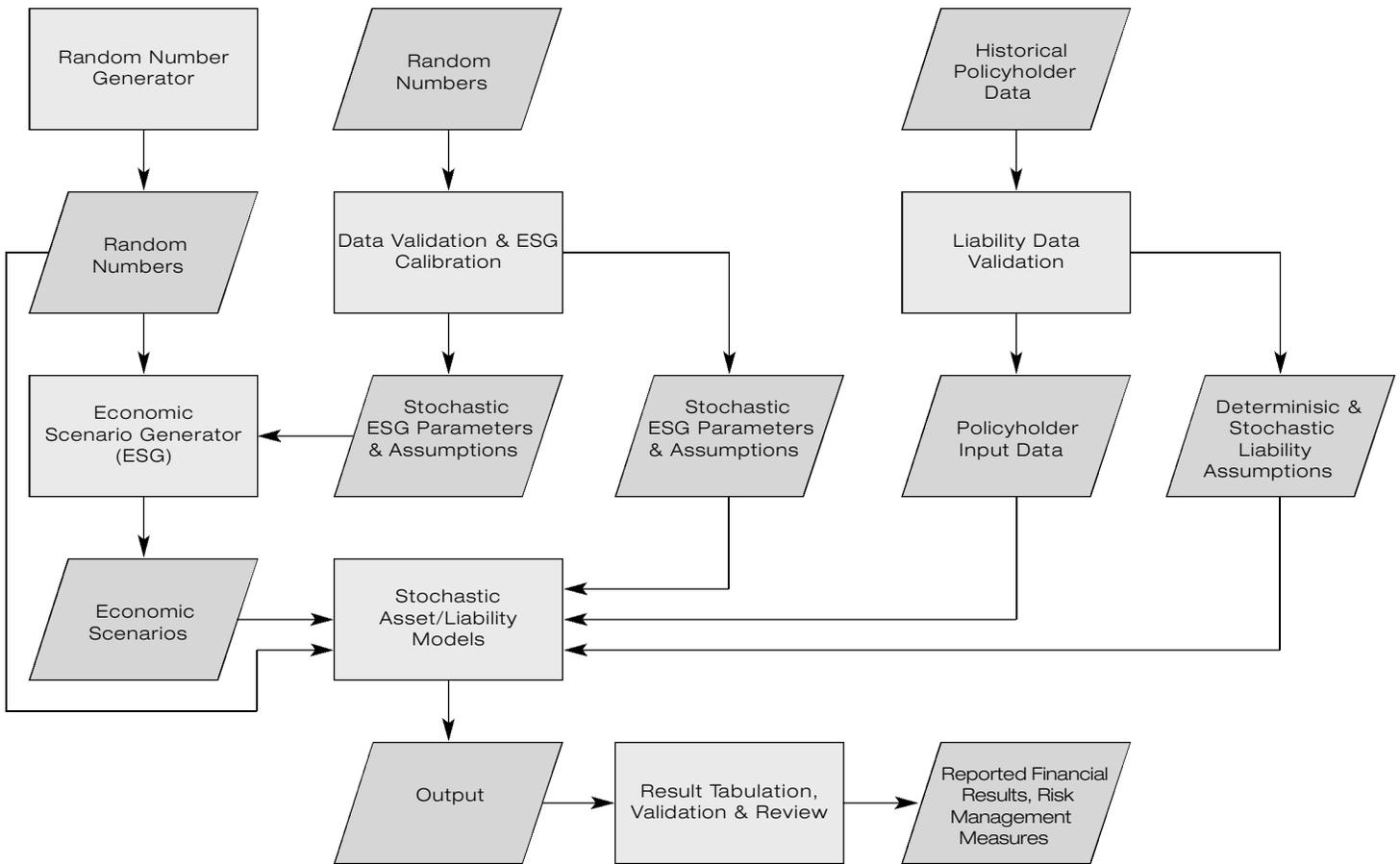
Is there really a starting and an ending point? No! Stochastic modeling tends to be an evolutionary process with a constant feedback loop. The steps that were followed while performing the stochastic simulation example used later in this article are depicted in the flowchart in Figure 1 on page 7. The rectangular boxes represent processes such as a mathematical calculation, while the parallelograms represent input/output operations—typically the transfer of data. In this case, three separate and distinct stochastic models were employed: a random number generator (RNG), an economic scenario generator (ESG) and a stochastic asset-liability model. The simulation results were then tabulated and various statistical measures generated.

In general, the development of a stochastic simulation involves the following steps:

- The identification of key objectives and potential roadblocks—this should be done before considering ways of solving the problem.
- Model specification—describe the process in general terms before proceeding to the specific.
- Development of the model—define key assumptions, input parameters, data requirements and what type of information should be produced.
- Fitting the model—gathering and interpretation of historical asset and liability data, calibration of the ESG, estimation of input parameters.
- Implementation of the model and tabulation of the simulation results.
- Analysis of results and sensitivity testing.

Finally, the communication of results in a useful and actionable manner to management is a critical step, if the potential value of stochastic modeling is to be achieved.

FIGURE 1: A GENERIC FRAMEWORK OF STOCHASTIC SIMULATION



RANDOM NUMBER GENERATION

The random number generator (RNG) is a critical building block of any stochastic simulation. The objective of the RNG sounds simple enough—to produce a very large sequence of random numbers that are uniformly distributed between zero and one. The sequence of random numbers is then mapped into a specified probability distribution in order to mimic the desired process, the results of which can then be quantified. However, the RNG, lacking glamor when compared in the broader context of the overall stochastic simulation, is often given little thought—or even totally forgotten about. In fact, a robust RNG is critical to the integrity of

the stochastic simulation, as a poor RNG can compromise all other sophistication. There are a number of desirable characteristics to check for, some of which are robustness independent of the seed number and periodicity. A quick search of the Internet will reveal a number of useful Web sites that detail various statistical test criteria for RNGs.

ECONOMIC SCENARIO GENERATION

The objective of the economic scenario generator (ESG) is to produce capital market or economic scenarios to be used for simulation purposes. There is a wide range of ESGs that are available. One needs to determine

continued on page 8

whether they require an economic or a statistical model, and an arbitrage-free or an equilibrium model. A fundamental question one should ask is whether the focus will be on the mean, median, or tail events—this will influence one’s selection of variance reduction methods, use of low discrepancy (or Quasi-Monte-Carlo) methodologies, as well as use of representative scenario selection methodologies. There are a number of desirable characteristics to check for in an ESG, some of which are:

- An integrated model incorporating stock market returns, interest rates, fixed income returns, inflation, currency and other relevant economic factors.
- A flexible component approach such that one only needs to run model components as needed.
- Incorporates the principle of parsimony. That is, the adoption of the simplest assumption in the formulation of a theory on a cost-benefit basis.

Careful consideration also needs to be given to the calibration procedure, as the simulation results can be highly sensitive to the parameter set-up of the ESG. Often insufficient time and effort is spent on data validation. Frequently, the data used to calibrate the ESG is limited, inconsistent, or possibly even incorrect. Issues also arise as to what historical period should be used to calibrate, as well as how often to re-calibrate. All of these issues warrant particular consideration. However, greater detail about these important issues is beyond the scope of this article.

STOCHASTIC SIMULATION OF A GMIB RIDER

A PRACTICAL EXAMPLE

The following example uses a guaranteed minimum income benefit (GMIB) rider that is attached to a variable annuity product. The GMIB rider is an embedded liability option that provides the account holder, for a given premium deposit, a minimum level of guaranteed income in the future. The objective of the

example is to illustrate how stochastic simulation can be used to produce reserve and capital measures for financial reporting of the GMIB rider. The measurement used is the present value of GMIB rider cash flows. The nature of the situation, which is not atypical of the current state of GMIB riders that were written in the late 1990s, is as follows:

- Guaranteed Account Value of \$1.4B
- Market Account Value of \$1.0B
- Five percent roll-up rate per annum
- Conservative interest and mortality assumptions were used in the original pricing of the GMIB rider

STOCHASTIC SIMULATION RESULTS:

A stochastic simulation is known for its ability to generate plenty of output. Results of the 1,000 scenario stochastic simulation are presented in a scatter plot format in Figure 2 on page 9. Although the chart looks interesting, the information content is low—the chart is not going to be very well received by senior management, who is looking for straightforward, concise and actionable information. Nevertheless, the chart is useful at a more technical level. For example, one is able to observe that, because of the low ratio of guaranteed account value to market value, there is a significant cap on the upside financial potential of the GMIB rider, while there is a significant amount of downside risk as approximately 68 percent of the simulations result in a negative net present value of GMIB rider cash flows. In addition, the largest negative value has roughly six times the magnitude of the greatest upside value. There also seems to be a slight positive relationship between present value and average equity return. All of this is, of course, dependent upon the assumptions used for the stochastic simulation.

CONDITIONAL TAIL EXPECTATION: CTE(%)

The conditional tail expectation (CTE) is a conditional expected value based on downside risk. CTE can be defined as the average

Careful consideration needs to be given to the calibration procedure.

FIGURE 2: SCATTER PLOT OF 1,000 SIMULATION RESULTS

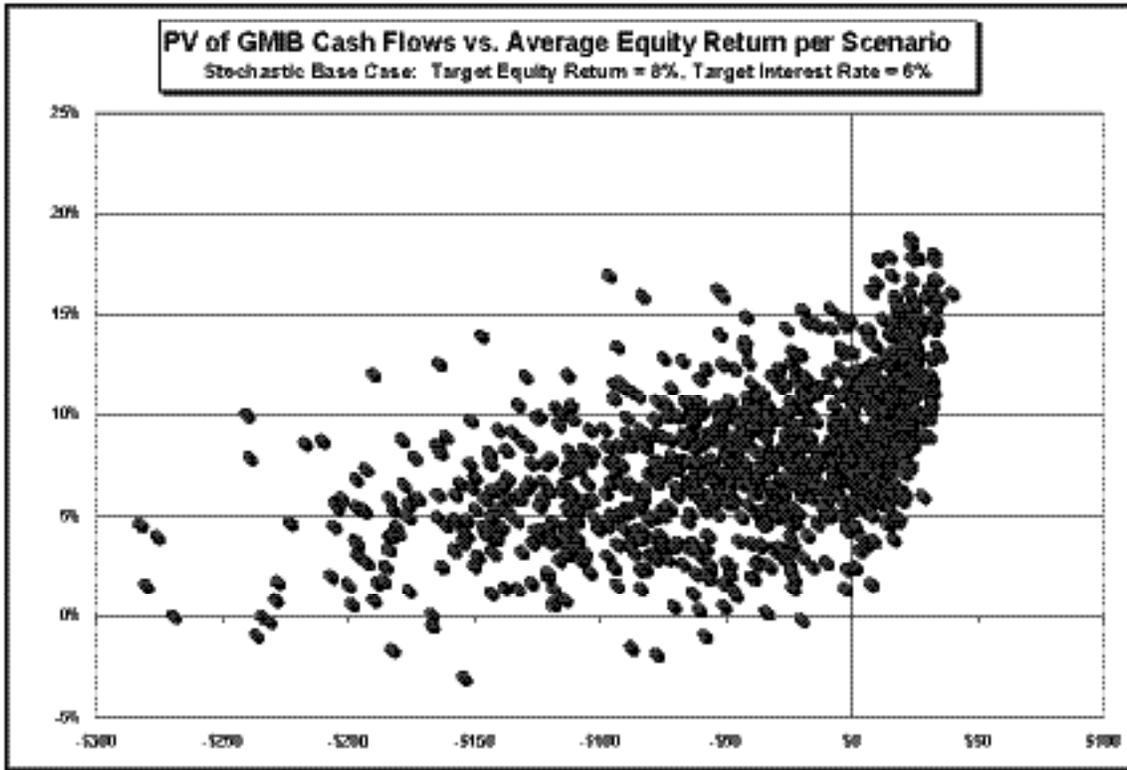


FIGURE 3: GMIB CTE MEASURERS

CTE(%)	PV of GMIB Cash Flows (\$ millions)
99.9%	- \$283
99%	- \$252
95%	- \$204
90%	- \$177
80%	- \$146
75%	- \$134
70%	- \$124
65%	- \$115
60%	- \$107
0%	- \$43

continued on page 10

of outcomes that exceed a specified percentile. The CTE(Q%) is calculated as the arithmetic average of the worst (100-Q)% results of the stochastic simulation. CTE is considered to be a more robust measure with greater information content than percentiles. The CTE measure can also be “modified”.

Selected CTE measures from the GMIB stochastic simulation are presented in Figure 3 on page 9. Reserve levels would likely fall in the range of CTE(60 percent) to CTE(80 percent), while a total balance requirement (reserve plus required capital) would likely be at the CTE(90 percent+) level. Driven by the fact that the embedded liability option in the GMIB rider is of material value to the account holder, the resulting reserve requirement is material at 10-15 percent of the market value of the accounts, while meeting a capital requirement

at the 20 percent+ level could be challenging to the insurer.

The results, by CTE and by percentile, are graphically shown in Figure 4 below. In this case, the information content is certainly better than that of Figure 2. One is able to observe that the CTE measure, by the use of averaging, produces a smoother result than the percentile measure. At the extreme end of the downside tail, the CTE and the percentile measure, by definition, converge. Also, sensitivity testing clearly shows that the results are sensitive to the assumed lapse rate.

SENSITIVITY TESTING

One is able to gain a better understanding of the dynamics underlying the stochastic simulation and the behavior of the system being mimicked by performing sensitivity testing. By

FIGURE 4: COMPARISON OF PERCENTILE AND CTE MEASURES

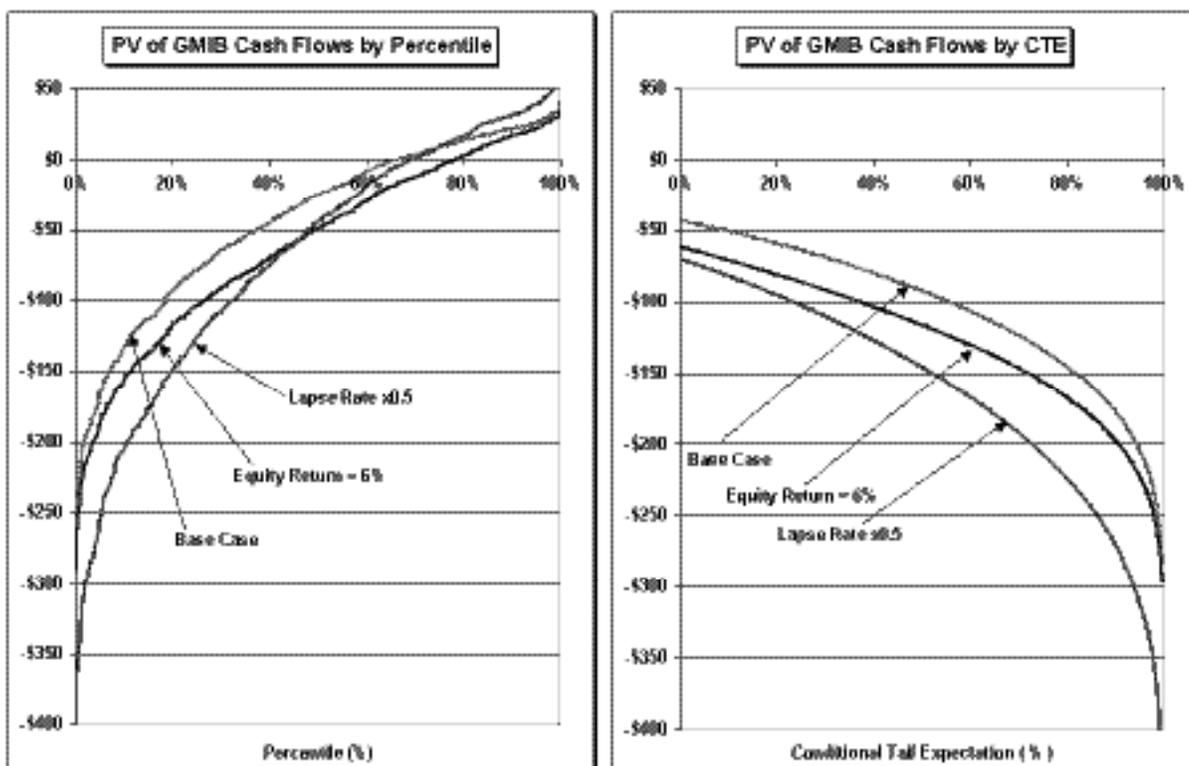
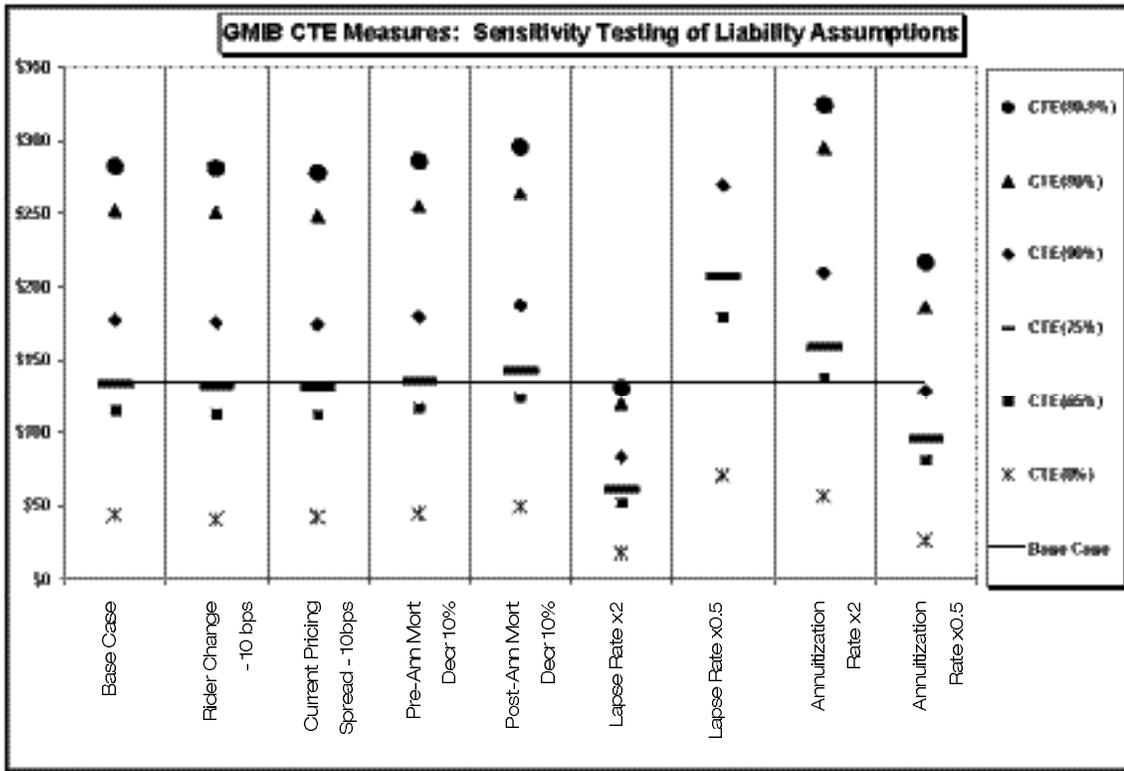


FIGURE 5: GMIB SENSITIVITY TESTING OF LIABILITY ASSUMPTIONS



changing one assumption or variable at a time, one can quantify the impact of a change in the assumption or variable on the end result. Sensitivity testing is also useful when dealing with model validation issues, as well as a check on the modeling of variable interactions. It allows one to identify and thereby direct more effort to key assumptions or variables to which the end result is most sensitive. One method of presenting sensitivity testing results of a stochastic simulation that has a very high information content level is shown in Figure 5 above. From this graphical presentation, one is able to observe that the results are highly sensitive to the lapse and annuitization assumptions, but are not very sensitive to mortality. A similar chart can also be produced for the investment-related assumptions.

IN SUMMARY

The development and implementation of a robust stochastic simulation framework can be

time and resource consuming and is inevitably an evolutionary process. It is important to understand the overall fundamentals and to keep focused on the business objectives. You need to learn to “walk” before you “run,” and must recognize that no one model fits all situations. Constantly perform validation and reality checks throughout all modeling steps. Be careful of becoming “married” to the method and the model, rather than the objective. Keep it simple, keep it practical, keep it understandable. Don’t use a sledgehammer to crack a walnut when a simple nutcracker will do. Add complexity on a cost/benefit basis, focusing on accuracy first and precision second. Don’t ignore data and model validation procedures. Avoid the creation of “black boxes” by adequately documenting all models. Where possible, adopt standard models for company-wide use. Finally, strive towards the production of actionable information and learn to effectively communicate the results. ☒



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Update on Valuation of Variable Annuity Guarantees

by James W. Lamson

Editor's Note: The section's Statutory Issues List Serve would be an appropriate forum for discussing concepts in this article.

This article focuses mainly on this budding love affair between the methodology proposed for RBC C-3 Phase II and the need for permanent reserve standards or variable annuity guaranteed living benefits.

Those who have been following the development of reserve requirements for guarantees of living benefits in variable annuities know that it has been like a long-running television soap opera. The industry and regulators have now grappled with this issue for over five years, and like a soap opera, there have been deaths, births and romances. The long anticipated adoption of the draft guideline dubbed Actuarial Guideline MMMM died a sudden death from a fatal blow dealt by NAIC's Life and Health Actuarial Task Force (LHATF) during its conference call in April 2002. However, out of the ashes of its cremation was born Actuarial Guideline XXXIX, which became effective last year-end and provides temporary reserve guidance. The current romance is with the methodology proposed for the RBC (Risk Based Capital) C-3 Phase II requirements introduced last December. This article focuses mainly on this budding love affair between that methodology and the need for permanent reserve standards for variable annuity guaranteed living benefits. The attraction between them lies in the opportunity presented to develop reserves using methods designed to more realistically measure the risks undertaken by insurers in the products they offer.

If you are interested in learning more about the details of Actuarial Guideline XXXIX, the American Academy of Actuaries has posted a practice note at http://www.actuary.org/pdf/practnotes/lifeVAGLB_dec02.pdf.

Rather than focus on the temporary reserve requirements of Actuarial Guideline XXXIX, this article discusses some of the recent efforts of the American Academy of Actuaries to adapt the proposed RBC C-3 Phase II methods to the calculation of reserves for variable annuities. The full account of these methods is contained in the December 2002 report of the Life Capital Adequacy Subcommittee to the National Association of Insurance Commissioners' Life Risk-Based Capital Working Group for determining the C-3 component of RBC for both variable life and most variable annuities. The report is titled *Recommended Approach for Setting*

Regulatory Risk-Based Capital Requirements for Variable Products with Guarantees (Excluding Index Guarantees), and is available at www.actuary.org/pdf/life/rbc_16dec02.pdf on the Academy's Web site. Alternatively, Max Rudolph has written an excellent article called "Current AAA Recommendation for RBC C-3 Phase II, that appeared in the June 2003 issue of *The Financial Reporter* and provides a very good overview of the method and provides a more comprehensive explanation than undertaken here.

RBC C-3 PHASE II METHODOLOGY

In a nutshell, current thinking is that reserves could be determined using a variation of the approach proposed for the calculation of the C-3 component of RBC. That is, (1) build a model of the variable annuity business and funds in force, (2) stochastically generate a large number of fund performance scenarios for the separate account assets meeting specific calibration criteria, and also derive forward rates from the swap curve for use with general account assets (or else stochastically generate companion interest rate scenarios, if you have capability for integrated scenario generation), (3) project the model and determine the greatest present value of cumulative negative surplus, if any, for each scenario, reflecting all revenues, benefits (net of reinsurance) and expenses, (4) average the (100-X)percent largest negative present values, with the average reflecting present values of zero substituted for those scenarios not producing negative surplus and (5) add this amount to the beginning assets to arrive at either reserves or total required assets. The average is known as the X percent Modified Conditional Tail Expectation (MCTE). The RBC C-3 Phase II proposal sets X=90 percent for the sum of RBC and reserves and determines risk based capital as the excess of that sum over reserves actually held. If this approach is used for reserves, X may be 60 percent or so, but that has not yet been determined.

VARIABLE ANNUITY RESERVE WORK GROUP

To potentially adapt this new method to the calculation of reserves for variable annuity guaranteed benefits, the Academy decided to be proactive and not wait for LHATF to request assistance. So it appointed Tom Campbell as chair of a new work group called the Variable Annuity Reserve Work Group, of which I am vice chair. We started work shortly after the beginning of this year and set about considering the different aspects of what would be involved in the development and adoption of a new reserve standard for variable annuity benefits. This resulted in our first report presented to LHATF at their teleconference held on April 8.

Our report, which is available on the Academy Web site at http://www.actuary.org/pdf/life/variable_030303.pdf, contains two appendices—one of which deals with whether the new reserve requirements could be adopted as an actuarial guideline or would require modifications to the Standard Valuation Law. Some argue that the method can simply be regarded as an interpretation of CARVM, and therefore, could be adopted as an actuarial guideline. Others believe that the method represents such a marked departure from current CARVM reserve calculations as to require modification of the Standard Valuation Law or adoption of a model regulation. New aspects of the report include the reliance on actuarial judgment and company experience for setting assumptions, the projection methodology coupled with the MCTE approach, the explicit incorporation of company expenses and the incorporation of incidence rates for elective benefits.

Since the first report was presented on April 8, the work group submitted a second report to LHATF at its June meeting in New York. This report may also be found on the Academy Web site at http://www.actuary.org/pdf/life/variable_june03.pdf.

CHALLENGING QUESTIONS

There are a number of other questions still to address, such as:

- Should the requirements apply to all variable annuities, or just to those policies having guaranteed benefits?
- Can we develop reserve requirements that use the same projections as for C-3 RBC Phase II, to avoid doubling the work?



- Should reserves be determined from the scenario results (i) at a particular percentile, such as the 83-1/3 percentile, or (ii) using CTE—Conditional Tail Expectation (i.e., average of the results beyond the 60th percentile, for example), or (iii) as a modified CTE (i.e., MCTE), for which scenarios having a positive present value are considered to have present value of zero in computing the average?
- Should the methods be applied to develop reserves for all contract benefits, or just for one or more types of guaranteed benefits?
- Should certain assumptions be prescribed, or can the actuary use professional judgment to develop all assumptions?
- How will valuation actuaries get the enormous number of calculations done in time for annual and quarterly statement preparation?
- May reserves be determined in the aggregate, as is done under the proposed RBC C-3 Phase II requirements, so that offsetting risks may be netted against each other?
- Could the effect of the RBC C-3 Phase II methods be pre-calculated and applied in a simplified manner at quarter ends, using a more precise seriatim calculation only at year-ends?

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- What effect will the new reserve requirements have on tax deductibility of reserves?

The Work Group has been laboring on these and other issues at a rather feverish pace, having subdivided our efforts into smaller groups dedicated to particular parts of the overall job. In one recent week, there were 10 hours of Academy conference calls devoted to the C-3 methodology and taxation issues! The result of this work will be two papers—one outlining the methodology issues yet to be resolved, and another paper that could serve as the basis for eventually writing whatever law, guideline or regulation that will be needed. Current drafts of these papers were included as appendices to the June report referenced above.

MODELING EFFORTS

In regard to the job of modeling these calculations, the RBC C-3 Phase II Work Group and the Reserve Work Group have combined efforts to bring more manpower to this important task, and also to ensure that identical methods will be applied to each effort. The RBC C-3 Phase II group still has a bit of unfinished business left over from its December report, one part of which is the development of simplified factors to use as an alternative to projections in certain circum-

stances for guaranteed minimum death benefits. Thus, as of this writing, no test reserve calculations have yet been performed by the modelers as they are working to develop the simplified factors. However, once the sample calculations become available, comparisons to current reserve levels can be made, along with the job of discovering yet unknown problems and complications. Like the marines, we're always looking for a few good men and women, so if you're interested in joining the modelers, just contact Steve English at the American Academy at English@actuary.org.

PARTICIPATORY UNDERTAKING

As we move forward on this project, we invite your participation and comments. After the December RBC C-3 Phase II report was exposed for comment by the NAIC, a blast e-mail from the Society of Actuaries finally elicited a number of comments, many of which would have been valuable to the RBC C-3 Phase II Work Group, had they been available earlier. So, we encourage you to follow the future progress of our efforts and please provide constructive feedback on it to Steve English at the American Academy of Actuaries. The work group's reports to LHATF will continue to be available on the Academy Web site to aid in keeping you up to date. ☒



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Risk Relevant Resources

The SOA Risk Management Task Force

Looking for timely, thought provoking information on risks affecting your line of business? Why not visit the SOA Risk Management Task Force Web site at <http://www.soa.org/sections/rmtf/rmtf.html>. It was created back in 2002 with Task Force subgroups researching and writing about all facets of risk that affect the industry. Not only will you benefit from the research and documentation available on the site, you'll find useful links to other risk oriented resources, network opportunities and events. Subgroups include:

- Economic Capital Calculation and Allocation
- Enterprise Risk Management
- Equity Modeling
- Extreme Value Models

- Health Risk Management
- Policyholder Behavior in the Tail
- Pricing for Risk
- Risk Based Capital Covariance
- Risk Management Metrics

Please take this opportunity to visit the site, add it to your list of favorites for frequent review and send your comments, questions and considerations to RMTF contacts.

The RMTF welcomes and needs your participation too! If you would like to learn more about the Risk Management Task Force in general or any of its subgroups, contact Dave Ingram or Valentina Isakina at david.ingram@milliman.com or visakina@soa.org. ☒

Update: RBC C-3 Phase II

by Max J. Rudolph

Editor's Note: The section's Statutory Issues List Serve or would be an appropriate forum for discussing concepts in this article.

This is a brief update to the RBC C-3 Phase II article in the last *Financial Reporter* and a companion to Jim Lamson's article, "Update on Valuation of Variable Annuity Guarantees," appearing on page 12 of this newsletter. The RBC and reserve groups continue to work closely together.

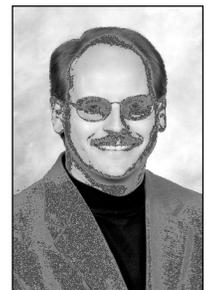
The American Academy of Actuaries' Life Capital Adequacy Subcommittee's C-3 Work Group, chaired by Bob Brown, has been hard at work this summer discussing specific issues, including those from comment letters. In general, the goal is to provide flexibility to companies that have significant blocks of variable annuities and generate fair factors for those that don't.

The target remains to have updated capital requirements in place by 2004, meaning that the final AAA recommendation needs to be submitted at the September 2003 NAIC meeting to meet logistical deadlines. It would then be "exposed" for comments for the next few weeks and will probably be voted on at the December meeting. Three areas of focus have been (i) how to test products with both fixed and equity accounts, (ii) developing factors for MGDB products including dynamic lapses and (iii) how to include product features like dollar for dollar withdrawals. Similar products, like those providing minimum death benefits to a mutual fund or group annuity type product, are also now included in the recommendation.

Keep in mind that the recommendation will generate total required assets. The capital portion of this is determined by subtracting the statutory reserve from the required assets, which includes the initial cash surrender value.

Watch for the work group's recommendation at the September NAIC meeting and for the discussion occurring at that meeting and in the weeks to follow. You can stay in the loop by

monitoring industry and actuarial publications. Consider writing a comment letter about issues important to you after the recommendation is presented to the NAIC in September. This is a new paradigm, and it's coming soon to a capital requirement near you! ☒



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Highlights of the June 2003 NAIC Life and Health Actuarial Task Force Meeting and Other NAIC Topics

by Ted Schlude

Editor's Note: The section's Statutory Issues List Serve or GAAP List Serve would be an appropriate forum for discussing concepts in this article.

I attended the NAIC Summer Meeting held June 19-24, 2003 in New York, New York. Topics included activities of the Life and Health Actuarial Task Force (LHATF) and various working group and committee meetings of the NAIC as described below.

LIFE AND HEALTH ACTUARIAL TASK FORCE

The LHATF met on Thursday to discuss special life topics followed by meetings on Friday of the Accident and Health Working Group and a general task force meeting. Special life topics are discussed below.

1. Annuity Non-forfeiture Law Implementation Issues:

LHATF reviewed the American Academy of Actuaries' Report from the Annuity Non-forfeiture Implementation Work Group. This group is supporting LHATF with respect to issues associated with implementation of the new annuity non-forfeiture law. Areas identified include:

- *EIAs*: For typical product structures under a range of assumptions, the value of the EIA benefit ranges from 2 to 4 percent, which is significantly above the one percent allowed in the new law. Other questions related to the certification included whether a one-time certification would be possible, how detailed the certification has to be, lag time between certifications, methodology or assumption criteria, and how to reflect persistency in point to point designs.
- *Five-Year CMT*: Non-forfeiture law wording specifies a fifteen month period over which the five-year CMT would be selected. Regulators' concern involves avoiding the possibility of gaming by selecting the lowest result as the index. Regulators directed the Academy to develop guidance that would require that

the methodology for selection of the five-year CMT be independent of the relative magnitude of the index.

- *CARVM Reserve Calculations*: How should the guaranteed rate beyond the initial period be selected under CARVM for contracts with an interest rate redetermination feature?
- *MGA Product Loads*: It was pointed out that the MGA Model Regulation (adopted by only five states) has loads consistent with the old annuity non-forfeiture law model (i.e., 90 percent on SPDA and 65 percent/87.5 percent on FPDA). The group will study possible revision to the MGA model regulation.
- *Focus on a Principle Based Approach to Regulation rather than a Rule Based Approach*: to accommodate future designs.
- *Questions and Answers*: Finally, the document presented a series of questions and answers related to certain specific questions.

2. General Non-forfeiture Project:

The Academy presented a report related to the need for revisions to non-forfeiture generally. Needs revolved around allowing flexible benefit structures such as multiple life, health, annuity and long-term care structures. Issues raised by the ACLI included uncertainty that might be created in Federal income tax law with such changes, as well as proper disclosure of the company plan concept to ensure that the plan does not become "guaranteed."

3. Standard Valuation Law Revisions – State of Domicile Opinion:

The Life Insurance (A) Committee had given LHATF a charge to investigate the ability of the states to support a state of domicile opinion. LHATF reconsidered its position and reconfirmed that it did not see a way in the

existing framework to support a state of domicile approach. The biggest concern involved the valuation certification where regulators in licensed states might receive no opinion as to whether the reserves met the minimum standards according to that state's laws and regulations, but simply a state of domicile opinion.

A small sub-group (Florida, New York, California and Texas) was formed to study a list of other valuation issues including:

- Need for a Certificate of Valuation.
- Need for deficiency reserves in the current framework.
- CRVM in an integrated CARVM framework.
- Annuities currently exempt from CARVM.
- Incorporating UL reserve standards into the SVL.
- Incorporating health reserve standards into the SVL.
- Including a requirement for good and sufficient provision in SVL.
- Possible use of current valuation tables for all inforce business.
- Review the appropriateness of the change in fund valuation method for deferred annuities.

Finally, it was noted that the C-3 Phase II project and approach ultimately recommended by the Variable Annuity Reserve Work Group may require a modification to the SVL, as well.

4. Update on C-3 Phase II Work and Variable Annuity Reserves:

Two Academy reports related to the C-3 Phase II project and Variable Annuity Reserve Work Group were discussed. A detailed C-3 Phase II report presented to the Life RBC Working Group is discussed later in this summary.

The C-3 Phase II overview included discussion of the modified Conditional Tail Expectation (mCTE) based approach, exclusion of variable life business because testing produced little additional capital, inclusion of all similar guarantees regardless of contract form (group annuity, group insurance, etc.), and removal of regular C-3 on variable annuity products with no guarantees.

The Variable Annuity Reserve Work Group of the Academy discussed the approach being taken for reserves. The Academy recommends that CTE (90) be used to establish a total capital and reserve requirement (average of the

worst 10 percent of the random scenarios). Modified CTE treats any positive results in the tail as zeros. Reserves would be set at some lower confidence level, such as mCTE(60), with the difference being RBC.

New York expressed concern that the Academy was recommending CTE (90) while the Canadian approach uses CTE (95). The regulators created an oversight group to discuss any regulatory implementation issues that might come up related to this project. New York had already provided a detailed comment letter.

Timing for the reserve recommendation would include exposure of the recommendation in December 2003, comments at the March 2004 meeting, planned adoption in June and finalized by the NAIC by the December 2004 meeting. Risk based capital has a slightly different schedule, with submission of the recommendation in September, earlier interim dates, but the same effective date target.

The Accident and Health Working Group discussed the following issues that may be of interest including a disability income (DI) proposal, a long-term care (LTC) proposal and the Academy LTC report.

1. Reserve Standards for Disability Insurance:

LHATF exposed a proposal to clarify disability income claim reserve methodology in the area of experience recognition. This guidance would apply to January 1, 2005 and later incurrals.

2. LTC Reserve Standards:

Work is continuing with respect to LTC reserve standards. First, Frank Dino's draft changes to the Health Insurance Reserves Model Regulation were discussed, which include:

- Forbids reflection of future morbidity improvement.
- Includes language related to provision for adverse deviation in morbidity.
- Reduces termination assumptions to the lesser of: one) 80 percent of pricing lapses or two) 6 percent (year 1), 4 percent (years 2-4) and 2 percent (years 5-on). Group sales are allowed to use 3 percent in years 5-on.
- Regulators are also considering guidance with respect to mortality assumptions such as the lesser of: 1.) GAM Table or 2) 95 percent of the pricing assumption.

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Next, an Academy Report was discussed that includes comments from various subgroups on experience reporting, morbidity improvement, credibility, termination experience and long-term objectives.

Finally, one regulator proposed that the mortality table in the law be updated to the 2000 Annuity Mortality Table. ACLI representatives expressed concern that an individual annuity table might be misused for LTC valuation. The ACLI also indicated that their members supported the lower lapse assumption and no morbidity improvement proposals, but were not supportive of the provision for adverse deviation language.

The LTC modifications were exposed for comment. The LHATF held its general matters meeting and discussed the following topics.

1. Variable Annuity GMDB

Dollar-for-Dollar Issue:

After the NAIC meeting in March 2003, New York requested that LHATF consider an issue related to reserve calculations for GMDB benefits in variable annuity contracts that contain what are referred to as dollar-for-dollar partial withdrawal provisions. Under these types of provisions, GMDB benefits decrease in absolute dollar amount with the dollar amount of the withdrawal. The significant decline in the equities market has created a significant amount of death benefit in these products. The valuation issue is whether Actuarial Guideline XXXIII, in conjunction with Actuarial Guideline XXXIV, requires one of the benefit streams to be an assumed partial withdrawal of all but an immaterial amount of an underwater policy to lock in what amounts to a single premium whole life policy. In this scenario, the CARVM greatest present value reserve would be equal to the cash surrender value plus a single premium whole life reserve. In addition, any future M&E and other charges vanish, due to the partial withdrawal of substantially all the fund value.

The NAIC has indicated that current statutory guidance (SVL, Actuarial Guideline XXXI-II and Actuarial Guideline XXXIV) is not perfectly clear with respect to this issue. This has put pressure on accounting firms in their year-end 2002 audit opinion, given the magnitude of the equity market's decline. Industry representatives indicated that this particular GMDB issue never was contemplated during the

Actuarial Guideline XXXIII and XXXIV deliberations. Some states have indicated that they believe Actuarial Guidelines XXXIII and XXXIV were intended to be interpreted literally and that XXXIII was intended to apply to these contracts and not superseded by XXXIV. Others are willing to take a more liberal interpretation which detaches Actuarial Guideline XXXIV from the Actuarial Guideline XXXIII elective and non-elective benefit stream approach.

It was pointed out that CARVM, which requires the company to look at the worst benefit stream from the company's standpoint, is not necessarily the best stream from the policyholder's standpoint. In this situation, a withdrawal to lock in a death benefit from the policyholder's standpoint may incur a surrender charge and trigger potentially negative tax implications for the policy.

A long-term solution to valuing variable annuity guarantees will come out of the Academy C-3 Phase II project, which is hoped to be reflected in the December 2004 RBC, and perhaps reserve, requirements. Regulators considered various short-term options and finally asked the Academy to provide a report for an interim conference call that discusses short-term solutions and other options. New York asked the Academy to quantify the dollar-for-dollar reserve issue as of December 31, 2003.

2. Need for Revisions to Life Illustrations Model:

The Academy report recommended potential solutions to a life illustration issue with respect to inherent mortality improvement reflected at higher attained ages. While the illustration model forbids reflection of future mortality improvement, assumptions such as a level percentage of the 1975-1980 table, appear to include some implicit improvement when the resulting table is compared to more current tables such as the RP 2000 or 2001 VBT. The recommendation focuses on educating the illustration actuary with respect to this issue, as well as possibly modifying Actuarial Standard of Practice No. 24, *Life Illustrations* to address this subject area in more detail.

3. Credit Life Mortality Table:

Work continues to arrive at a satisfactory framework in which to use the 2001 CSO Male Ultimate Table for single premium credit life

insurance. A conference call will be scheduled to discuss this topic further.

4. Other Matters:

Sheldon Summers of California raised two valuation issues for LHATF to consider.

- *MVA Contracts in the General Account:* The first issue relates to MVA contracts and whether surrender charges should be considered contingent as a result of the MVA feature, as well as whether a positive MVA should serve to increase reserves, as a result of the cash value floor, even though assets are held at book value.
- *Reinsurance and Use of Mean vs. Mid-Terminal Reserve Approach:* It is common for life reinsurance to be on an annual premium mode basis. Under a mid-terminal plus net unearned premium reserve basis, this creates what the state interprets as an inconsistent result with the reinsurance model regulation. In this situation, a net unearned premium based on actual premium mode and valuation assumptions is established on a direct basis, but a net unearned premium reserve credit on an annual mode basis is taken for the reinsurance offset. The regulator argues that, since the valuation net premium typically is much larger than the gross premium, taking credit for more than the gross unearned premium violates the reinsurance model regulation and overstates the true surplus benefit.

5. Reserves for GIC's with Bailout

Provisions (Actuarial Guidelines GIC's):

AG GIC's, which had been deferred at the March 2003 meeting because there was no quorum, was adopted during an interim conference call.

LIFE INSURANCE (A) COMMITTEE

I attended several meetings of working groups reporting to the Life (A) Committee as summarized below.

1. Viatical Settlements Working Group:

The working group continued to work on the verification of coverage form which needs to balance responsibilities of the viatical settlement company and the insurer that does not want information provided to be interpreted as

if it were a legal opinion (such as questions regarding incontestability). It was noted that company practices vary widely with respect to group conversions and incontestability (some companies waive full two years on any group conversions, some start a new two-year period, and others give credit for the period where the group coverage was in effect).

Next, the working group discussed various proposed broker and provider reporting forms that would provide actual mortality experience, number of policies reviewed, number of policies represented, net amount viaticated and net amount paid viators.

2. Variable Annuity Functional Regulation Working Group:

The Functional Regulation of Variable Annuities Working Group concluded that regulation of variable annuities will be left unchanged in terms of the regulatory framework (SEC, NASD, state insurance/securities departments). Eight state jurisdictions regulate variable products as securities but most leave the regulation to the insurance regulator. The North American Securities Administrators Association (NASAA) had argued that variable business be considered securities and subject to the regulatory authority of state securities regulators. This would have introduced another layer of regulation on a product that is already heavily regulated.

RISK-BASED CAPITAL TASK FORCE

Several working group and task force meetings are discussed below.

1. Life RBC Working Group:

The Life RBC Working Group had a full agenda of projects described below.

- *Worker's Comp Carve-Out:* The working group adopted changes effective December 31, 2003 for worker's comp carve-out coverages. The methodology follows the P&C structure. Worker's comp carve-out factors are illustrated below.

Premium Factor	36.4%
Reserve Factor	34.7%
Reinsured Recoverable Factor	9.5%

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At a later meeting, the RBC Task Force reviewed the proposal and decided to defer adoption of this item, preferring to expose the workers' comp carve-out proposal for an additional comment period.

- *C-3 Phase I Follow-up:* Discussion took place as to whether the C-3 Phase I testing was intended to apply to the fixed portion of variable annuities. The Academy will review the appropriateness of C-3 Phase I treatment for all VA fixed account products both those products sold as fixed, as well as the fixed portion of regular variable annuities.
- *C-3 Phase II Report:* The Academy presented its June 2003 C-3 Phase II report, which included specimen numerical values for death benefit factors. The scope of the Phase II project is intended to include both the fixed and variable portions of variable annuities. The Academy report summarizes comments received on the December 2002 report in 14 separate comment letters. Changes made to the December 2002 report include: 1) exclusion of variable life, because it created little or no additional required capital, 2) inclusion of all "like-type" guarantees that might not necessarily be called variable annuities, and 3) to include variable annuities with no guarantees in this process, replacing the current C-3 charge on the variable portion of these

contracts with the value resulting from modeling. The Academy hopes to nail down final issues in a document for regulators to consider in September 2003.

Next, testing results were presented for several GMDB structures, in-the-moneyness levels and policy durations. A brief summary of capital (including reserve) charges under the baseline scenario is provided in the table below.

Testing for VAGLB benefits will be performed and presented in the September 2003 report. The LHATF formed a regulatory issues group to monitor activities of the C-3 Phase II group. One particular area of concern involves use of CTE (90), which is the Academy recommendation, in light of the Canadian requirements of CTE (95).

Industry representatives expressed concern that the final report of the Academy receive a proper amount of exposure, given the potential implications of this project on life company reserve and capital requirements.

- *Modco Reinsurance Treatment:* The Academy was asked to look at several other RBC issues related to Modco reinsurance: 1) bond size factor, 2) asset concentration factor and 3) the issue of offshore vanishing RBC. The Academy report was exposed for comment. No changes for bond size were recommended. With respect to asset concentration, the Academy report suggests that a materiality

Total Capital as a Percent of Account Value Base Assumptions - CTE (90)

Benefit Type/In-the-Moneyness (ITM)	At Issue	Duration 3.5				Duration 6.5				Duration 9.5			
		0%	-20%	0%	+20%	+40%	-20%	0%	+20%	+40%	-20%	0%	+20%
GMDB - ROP	0.62%	0.02%	0.23%	1.08%	2.21%	0.00%	0.02%	0.22%	0.53%	0.00%	0.01%	0.04%	0.14%
GMDB - Rollup	1.32%	0.04%	0.27%	1.18%	2.75%	0.01%	0.04%	0.20%	0.70%	0.01%	0.05%	0.19%	0.61%
GMDB - MAV	0.58%	0.01%	0.08%	0.50%	1.45%	0.00%	0.00%	0.03%	0.17%	0.00%	0.01%	0.02%	0.10%
GMDB - High	1.25%	0.03%	0.23%	1.00%	2.52%	0.00%	0.01%	0.09%	0.36%	0.00%	0.01%	0.08%	0.26%
GMDB - EDB	0.43%	0.00%	0.13%	0.79%	1.88%	0.00%	0.01%	0.13%	0.43%	0.00%	0.01%	0.02%	0.10%

Note: High = Higher of 5% Rollup and Annual Ratchet
EDB = ROP + 40% Enhanced Death Benefit

threshold such as 50 percent of investment income be used to trigger movement of the assets from the ceding company's books to the reinsurer's books. With respect to vanishing RBC, the Academy has suggested written guidance to the ceding company to supply sufficient information for the reinsurer to calculate RBC. The Life RBC Working Group will consider for adoption the ModCo dividend liability proposal, which was received in March, 2003, in an interim conference call.

- *Academy Long-Term Care C-2 Recommendation:* There was not enough time to discuss an Academy long-term care recommendation which could reduce required capital for long-term care substantially, especially for larger long-term care writers (greater than \$75 million of premium). The proposal could increase substantially the required capital for smaller companies based purely on the statistical analysis. It was also suggested in the report that capital should not be based strictly on premium and claim reserves, but also reflect the relative level of incurred claims. The long-term care report was exposed for comment and will be discussed at an interim conference call. This proposal was also received at the RBC Task Force meeting and received a less favorable response from regulators who were concerned about dropping capital requirements for a line of business which has many start up companies. In addition, several reserve issues are being studied on long-term care including

use of morbidity improvement and overly aggressive termination assumptions in reserving.

2. RBC Ad Hoc Subgroup:

The Ad Hoc Subgroup was formed to study the RBC formula generally in light of many of the recent P&C company failures. After many Executive Sessions where regulators studied the reasons for actual company failure, the Ad Hoc Subgroup is studying what modifications might be effected to address some of the issues identified. The two items being studied are described below.

- A. *More Rigorous Trend Test:* The Ad Hoc Subgroup used the 2000, 2001 and 2002 NAIC RBC database to study whether increasing the trend test triggers (from a 250 percent trigger to 400 percent or 500 percent) or strengthening the trend test formula might help identify troubled companies. Industry concerns involved how many additional false positives might be generated.
- B. *Increasing RBC Authorized Control Level (ACL) Factor from 50 percent to 75 percent:* The working group reviewed statistics from the 2002 database which are illustrated in the table below. The Academy was asked to look at the analysis prepared by the Ad Hoc subgroup and to comment on the approach and/or suggest alternative analyses. Finally, the regulators proposed moving the 50 percent to 75 percent for Property and Casualty companies to capture

Total Capital as a Percent of Account Value Base Assumptions - CTE (90)

	50% ACL	75% ACL	Notes
Life	1.9%	5.8%	No change. Few insolvencies in 2000-2002 for life companies.
P&C	4.5%	11.7%	Increase Trigger to 75% ACL.
Health	12.0%	29.7%	No Change. Already catching 12% of companies.

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a large percentage of the companies in an industry which has had a significant number of insolvencies recently. There would be some type of transition period. Interested parties were asked to comment on this proposal during a 45-day exposure period.

C. *RBC Task Force:*

The RBC Task Force reviewed meeting summaries of the Life, P&C and Ad Hoc subgroup and adopted each report. Finally the group discussed what, if any, RBC disclosure is required in the notes to the financial statement with respect to state prescribed and permitted practices that could have an impact on RBC. Regulators concluded that auditors would require such disclosure regardless of the explicit statutory guidance.

FINANCIAL CONDITION (E) COMMITTEE

I attended the following meetings of working groups reporting to the Financial Condition (E) Committee.

1. Emerging Accounting Issues

Working Group:

The Emerging Accounting Issues Working Group discussed two topics of interest related to accounting for intercompany pooling arrangements and admissibility of investments recorded based on audited GAAP equity when a qualified audit opinion has been provided.

- *Intercompany Pooling:* This issue relates primarily to P&C arrangements where companies historically have used book values for assets and statutory value for liabilities (undiscounted). Certain regulators have proposed marking the assets to market in the accounting. The industry argues that book treatment is proper because the liabilities are not being marked to market (i.e., being discounted). The issue was referred to the Statutory Accounting Principles Working Group.
- *Qualified Audit Opinion:* Statutory accounting accepts GAAP equity as the statutory carrying value for entities that are subsidiary, controlled and affiliated entities. However, this interpretation would require the entity to have an unqualified audit opinion. Interested parties stated that there are many items

that might not have an effect on GAAP equity that could cause an audit opinion to be qualified—an example would be a balance sheet only opinion. This topic was deferred until September 2003.

2. Statutory Accounting Principles

Working Group:

Meeting Agenda: The Accounting Practices and Procedures Manual Appendix A will be updated to include the new Model Regulation 814, *Recognition of the 2001 CSO Mortality Table for Use in Determining Minimum Reserve Liabilities and Nonforfeiture Benefits*. Finally, regulators discussed the lack of clear guidance related to the Additional Minimum Pension Liability. Significant accruals to this liability at year end 2002 occurred, and the guidance is unclear as to whether these hits run through income or the capital and surplus account. The regulators will try to clarify that these accruals should be run through the capital and surplus account, similar to unrealized gains and losses.

3. NAIC/AICPA Working Group:

This working group adopted revisions to the Model Rule Requiring Annual Audited Financial Reports which is designed to make use of CPA workpapers by the insurance department examiners more effective. Next, they discussed modifications to the P&C Annual Audited Financial Statement Instructions to ensure that auditors were reviewing the data that the actuary was using in claim reserve analysis, etc. Finally, the AICPA updated the NAIC on current projects:

- *Non Traditional Long Duration Contracts:* A final SOP is expected to be issued in July 2003, effective for statements beginning after December 15, 2003.
- *DAC on Internal Replacements:* This SOP was released in March with comments through June 2003. AcSEC expects to have proposed revisions completed in July 2003.
- *Separate Account Financial Highlight Guidance:* This SOP will enhance requirements for reporting financial highlights of separate account entities. An exposure draft is expected in July with a sixty-day comment period.
- *Quota Share Reinsurance:* The AICPA continues to work on a paper related to quota share reinsurance transactions.

4. International Accounting Standards Working Group (IASWG):

Items discussed at the IASWG meeting included updates from the NAIC on its attendance at IASB meetings and the IAIS Accounting Subcommittee as well as a presentation from the ACLI related to implications of the IASB approach for a sample product, immediate annuities. It appears that the IASB Phase II insurance project has slowed to a halt. A sunset clause was passed for Phase I that says if Phase II is not completed by 2007 then Phase I guidance would apply at that point. The sunset language says to look to IAS, guidance first, then to recognized international accounting standards which would probably mean that U.S. Companies would revert to GAAP guidance at that point.

5. Invested Asset Working Group:

The Invested Asset Working Group (IAWG) discussed the following projects summarized below:

- *Schedule BA Project:* The SVO believes it has expertise to evaluate certain securities now contained in Schedule BA—Other Invested Assets. The industry wants to be sure that the project does not turn into a Schedule BA witch hunt.
- IAWG adopted guidance that would classify money market funds as cash equivalents, split between exempt (government backed) and non-exempt, so RBC is not affected.
- *iShare Funds:* IAWG discussed a new type of investment called iShare. Insurers are using this type of investment as a diversified basket of corporate bonds. Therefore, it appears appropriate for exemption from traditional mutual fund rules. The SVO will review the investment and provide a recommended treatment. It has daily transparency compared to mutual funds which typically are only transparent on quarter ends. Mike Moriarty of New York also asked for the SVO to look at Class 1 bond funds generally as part of the project.

6. Rating Agency Working Group:

Regulators held a face to face meeting with representatives of all the major rating agencies. The purpose was to pursue what regulators might do to better plan and work with rating

agencies given the impact their rating can have on insurance entities. It is clear that regulators are interested in some form of advance warning system that might allow them to get involved prior to a rating agency downgrade. Rating agencies described their process as independent of the regulator until the paths converge. Rating agencies are provided much proprietary and confidential information so discussions directly with regulators are difficult. Furthermore, once a rating agency decision has been made, they are compelled to release the new rating as soon as possible. Moody's indicated that they rate entities in over 70 jurisdictions and that providing proprietary information in all these jurisdictions would not be practical because other regulators might misuse such information.

OTHER MATTERS

I attended two other meetings of interest discussed below.

1. Reinsurance Task Force:

As a result of feedback received from the Insolvency Task Force, it appears that the Reinsurance Task Force will probably not support relaxing the 100 percent collateral requirements currently imposed on foreign reinsurers, regardless of the foreign entity's financial strength. Part of the issue relates to the reliability of financial statements prepared under a foreign country's GAAP standards and part relates to enforceability of U.S. judgments in courts abroad.

2. Consumer Protection Working Group – Hearing on Arbitration Clauses in Insurance Contracts:

The NAIC is investigating whether or not mandatory arbitration clauses in a contract of adhesion create a public policy issue. Testimony indicated that good arbitration clauses are good for policyholders and companies because they eliminate much of the expense of litigating a dispute. Certain consumer oriented commissioners are clearly against any type of clause that appears to limit the policyholder's option for remedies.

The next NAIC meeting is scheduled for mid-September in Chicago. ☒



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Principles of Capital Market Modeling

by Andres Vilms

Editor's Note: The section's Statutory Issues List Serve or GAAP List Serve would be an appropriate forum for discussing concepts in this article.

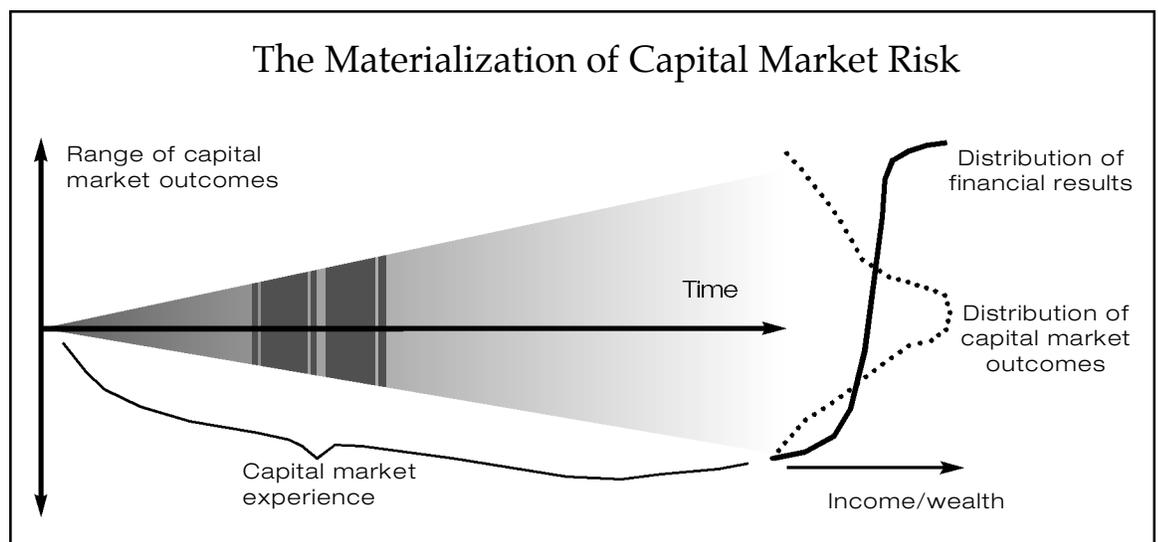
Capital market modeling has become a key competency for actuaries in their role as the primary analysts and managers of risk at life insurance companies. Unfortunately, the highly complex technical aspects of capital market models, along with the mystique that surrounds them, often hinder the use of such models and the interpretation of the information that they produce. Thus, it is important to understand the conceptual framework for capital market modeling, both as a starting point and as a guide to resolving practical issues that may arise. This article examines that framework; a forthcoming article will address important technical considerations.

THE SIGNIFICANCE OF THE CAPITAL MARKETS

Uncertainty is a hallmark of the capital markets in which financial instruments trade. Market interest rates, which define the interest rates that can be earned on new fixed-income investments and determine the market values of existing ones, fluctuate over time. Similarly, the returns on equity securities vary by period. This uncertainty, or volatility, influences life insurers' financial results in a number of important ways.

For an insurer's invested assets the relationship is direct, as the returns are determined in the capital markets. Also, the cash flows from assets with embedded options (callable bonds, mortgage-related and other asset-backed securities) are strongly influenced by the capital markets. On the liability side of the balance sheet, fixed-rate products (universal life, fixed deferred annuities) provide policyholder returns linked to insurer investment performance, and are subject to interest-sensitive policyholder behavior. For variable products (variable universal life, variable annuities), both revenue and the cost of guarantees are determined by the performance of the investment accounts to which policyholder funds are allocated.

The uncertainty of financial results caused by capital market volatility transmitted through assets and liabilities is what constitutes *capital market risk*. (The exhibit below provides a simplified illustration of this dynamic.) It is imperative that an insurer understand: (a) the magnitude of the risk to which it is exposed, (b) what price to charge for assuming the risk and (c) how best to mitigate the risk. Any such analysis must reflect capital market volatility and its interaction with the basic financial dynamics of the assets and liabilities.



DETERMINISTIC ANALYSIS

Deterministic scenario analysis is one approach to measuring capital market risk. It involves the specification of a set of capital market outcomes, or scenarios, for which financial results are to be modeled. Each scenario describes the pattern followed, over the period to be studied, by each capital market variable that is considered relevant to the analysis. The modeler defines a set of such scenarios on a judgmental basis. This might reflect a belief as to how the future will unfold, a preconception of the nature of the capital market risk to be analyzed, or a perception of certain scenarios as especially illustrative.

Perhaps the simplest form of deterministic analysis is so-called “what if” analysis—sensitivity testing across a small set of capital market outcomes that are of special interest. Alternatively, deterministic scenarios can be designed to span the range of potential outcomes, as in the case of the “New York Seven” cash flow testing scenarios. Regardless of how the scenarios are chosen, the modeled financial results under them can provide some information about capital market risk, which appears as the variation in results across scenarios. (Note that single-scenario expected results fail to capture any capital market risk.) Furthermore, the baseline results can serve as a benchmark against which to evaluate alternative strategies.

The weakness of deterministic analysis is that it sidesteps the question of the (unknown) probability distribution of capital market outcomes, and thus provides no probabilistic information about the insurer’s financial outcomes. Specifically, there is no indication as to the probabilistic significance of the chosen scenarios. Without such indication, the full meaning of the modeled results is not known. Thus, a rigorous analysis of capital market risk must seek to capture the full distribution of financial results.

STOCHASTIC ANALYSIS

Stochastic analysis seeks to explain the effects of uncertainty. It is rooted in the theory of stochastic (random) processes and the calculus thereof, and encompasses a variety of techniques. The best-suited tool for a given problem depends on its complexity. If the underlying dynamics are simple enough, stochastic calculus may yield a closed-form solution, such as the Black-Scholes formula for option valuation.



Problems involving outcomes or actions in multiple periods are better handled by the lattice (or tree) method. In this method, the movement of a capital market variable over time is characterized by a series of small movements over short intervals, with a limited number (generally two or three) of pre-defined movements of pre-defined probability considered in each interval. The lattice models the probabilistic evolution of the capital market variable over time as a collection of modeled probability distributions at the end of each interval.

In practice, the lattice method can’t handle problems that involve path dependency—where a financial result depends not only on the ending value of the underlying capital market variable but also on the path it followed over time. This description is applicable to most models of life insurance liabilities, so the lattice method is rarely used. Consequently, the preferred method for stochastic analysis of life insurance capital market risk is Monte Carlo simulation.

MONTE CARLO SIMULATION

Monte Carlo simulation involves generating a large number of equal-probability scenarios randomly, so as to simulate the full distribution of potential outcomes. It consists of the following steps:

1. Specification of the discrete-time stochastic process for each capital market variable to be modeled. The process for variable x is expressed as a formula for the discrete-period change Δx in time Δt . The general form is: $\Delta x = \Delta \Delta t + b (\Delta \Delta t)$

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This is the discrete-time version of the process known as generalized Brownian motion. The term in parentheses, where ϵ is a random draw from the standard normal distribution, is the random shock in a given period—the source of randomness in the process. This component is scaled by b , the volatility of the process. The coefficient a represents the expected “drift” per unit time.

The actual form chosen for modeling a particular capital market variable will depend on how the variable is believed to move in real life. Possible modifications to the generalized formula include: additional terms, coefficients that are functions of x and/or t , and correlations with other capital market variables.

The realistic basis consists of some blend of empirical data and judgmental considerations.

2. Each stochastic process must be parameterized—the value of each coefficient in the formula must be specified. (The next section discusses the considerations that apply here.)
3. The modeling interval Δt and the overall modeling horizon must be selected. Together, they determine the number of discrete model periods.
4. For each scenario, each modeled capital market variable is projected over the modeling horizon, period by period (as described in step 5). This procedure is referred to as scenario generation. When it is complete, the financial results for the assets and liabilities being analyzed can be calculated for that scenario. This requires that the underlying model of assets and liabilities properly reflect their sensitivities to the capital markets. However, the distinction between deterministic and stochastic analysis has to do only with the nature of the scenarios that are used, not with the model itself. Any suitable model of assets and liabilities can be “stochasticized” by applying it to stochastically-generated scenarios.
5. For each model period within a scenario (step 4), the change in value Δx of each modeled capital market variable is calculated by sampling a random ϵ from the

standard normal distribution and applying the formula for the stochastic process. Each variable’s end-of-period value is equal to its starting value plus the change in value. This step is repeated for all model periods, to project the complete evolution of the variables over the modeling horizon.

6. When financial results have been projected for all stochastic scenarios, the simulation is complete. The simulation results provide information about both return—the overall level of profit across the scenarios—and risk—the variation in profit or value across the scenarios. The return and risk can be expressed as summary statistical measures, such as mean profit and the standard deviation thereof. Alternatively, the scenario results can be charted, to show the full distribution of results.

ADDITIONAL CONSIDERATIONS

The parameterization of any stochastic process (step 2 above) begins with an important choice: whether the assumptions are “risk-neutral” or “realistic.”

- The *risk-neutral* basis consists of the parameters uniquely implied by current market prices of traded securities. If, as is widely accepted, the capital markets are arbitrage-free, the price of any traded security can be derived by risk-neutral valuation. This method assumes that all assets earn the risk-free rate of return and that all future cash flows are properly discounted at the risk-free rate. By applying that valuation rule, stochastic model parameters can be derived from current market prices. The scenarios generated using those parameters will, in aggregate, display a return distribution consistent with the current market prices and the assumption of risk-neutrality.

There are two important aspects of this method that should be stressed. First, the theory does not make any statement as to the distribution of actual capital market outcomes; it simply defines a methodology for calculating arbitrage-free prices. Second, the risk-neutral scenarios are just

artifacts of valuation; individual scenarios have no other meaning.

- The *realistic* (or *real-world*, as it is also called in the literature) basis consists of some blend of empirical data and judgmental considerations. The intent, whether explicit or implicit, is to express the modeler's best estimate of the distribution of future capital market outcomes. This is obviously not subject to as many constraints as is the risk-neutral basis.

There is debate in some quarters about the respective validity of these two assumption bases. That is an artificial conflict—each basis has its proper uses. The choice of basis should be determined by the purpose of the stochastic model. In general, scenario-based analyses can be grouped into two broad categories, from which the choice of assumption basis naturally follows:

- A *valuation* analysis involves the calculation of a point-in-time value reflecting prevailing conditions as they affect that value. For the calculation of the market value of a traded security, whether now or at some assumed future state, risk-neutral assumptions are clearly suitable. This is analogous to the application of reserve valuation rules to calculate a reserve at a given point in time.
- A *projection* analysis is focused on possible future outcomes. This type of analysis is more consistent with the realistic assumption basis. Risk-neutral scenarios are ill suited to this purpose, due to the limitations referred to previously. Moreover, if a projection analysis does not include the discounting of results at the risk-free rate, the necessary conditions for risk-neutral valuation are not met.

Note that actuarial analyses very often take the form of a projection analysis with numerous valuation analyses—to determine future asset market values or scenario-based liability values—embedded within. Thus, a modeling exercise may require the generation of both risk-neutral and realistic capital market scenarios.

CONCLUSION

Although capital market modeling is a highly sophisticated activity, it is based on a very well-developed and intuitive conceptual framework. The ultimate objective is to assess risk by estimating the probability distribution of financial results, as filtered through the distribution of capital market outcomes. When faced with practical modeling challenges or difficulty explaining model results, the actuary may often find it helpful to remember the objective. ☐

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FAS 133 Implementation Issue B36: Implications for the Financial Reporting of Reinsurance

by Rebecca Kao Wang and Tara JP Hansen

Editor's Note: The section's GAAP List Serve would be an appropriate forum for discussing concepts in this article.

Financial Accounting Standard No. 133, *Accounting for Derivative Instruments and Hedging Activities*, effective in June 2000, required that derivatives be recognized as assets or liabilities and measured in the financial statements at fair value. Derivatives include financial instruments that hedge against variations in fair value, cash flows or foreign currency rates. Certain instruments, including some insurance products, although not derivatives, contain embedded derivatives. Under FAS 133, certain embedded derivatives must be bifurcated from their host contracts and be reported at fair value, with changes in this value flowing through the income statement.

During the initial implementation of FAS 133, many companies acknowledged the existence of an embedded derivative in Modified Coinsurance ("ModCo"), Coinsurance with Funds Withheld ("CFW"), and other contracts with similar provisions. However, they believed that the embedded derivative was "clearly and

closely related" to the host contract, and therefore exempt from bifurcation requirements.

In 2002, numerous discussions and public comments among the AICPA, SEC and FASB focused on this issue. In April 2003, the FASB released FAS 133 Implementation Issue B36 ("DIG Issue B36"), "Embedded Derivatives: Modified Coinsurance Arrangements and Debt Instruments That Incorporate Credit Risk Exposure That Are Unrelated or Only Partially Related to the Creditworthiness of the Obligor Under Those Instruments." DIG Issue B36 will have a dramatic effect on the way both ceding and assuming companies account for ModCo and CFW reinsurance contracts. This guidance is effective the first day of the first fiscal quarter beginning after September 15, 2003. All affected financial instruments will need to be accounted for prospectively, with no restatement of prior financial statements required or permitted.

Although it is only the presence of third-party credit risk in a ModCo or CFW contract that is triggering the need for both parties to bifurcate an embedded derivative, DIG Issue B36 deliberately never describes the embedded derivative as a "credit derivative," because the FASB has acknowledged that each contract may have unique features. Some parties may analyze the embedded derivative feature and conclude that it is solely credit related. Others may conclude that the embedded derivative feature is a compound derivative combining both third-party credit risk and interest rate risk.

A PRIMER ON REINSURANCE CONTRACTS

ModCo is a type of reinsurance where the ceding company retains the assets supporting the reinsured reserves. The ceding company pays the reinsurer a proportional share of the gross premium less a specified expense allowance, as well as a return on the assets. The reinsurer, in turn, pays the ceding company the increase in reinsured reserves as well as benefit claims. Generally, the return on assets that the ceding company pays the rein-



surer in the form of a ModCo interest adjustment reflects the actual investment return on either some specific segregated group of assets or the underlying asset portfolio in the ceding company's general account. The reinsurer is therefore exposed not only to the counter-party credit risk of the ceding company, but also to the credit risk of the underlying assets held by the ceding company and issued by third parties. In effect, the ceding company has, at a minimum, purchased credit protection on the portion of these assets backing the reserves while the reinsurer has issued this protection. Thus there is an embedded derivative under which the reinsurer bears the default risk of the third party securities held by the ceding company, in addition to interest rate and other risks.

CFW is a type of coinsurance under which the ceding company retains a portion of the initial premium at least equal to the ceded statutory reserves, and the reinsurer retains the expense allowance with appropriate payables and receivables on both parties' balance sheets. Similar to a ModCo agreement, the interest adjustment to the reinsurer usually reflects the actual investment return on an underlying asset portfolio, in which case an embedded derivative is present.

Some reinsurance arrangements contain experience refund provisions under which the reinsurer pays a refund to the ceding company based on the actual performance of the reinsured block of business. This experience refund may reflect a number of factors, such as mortality, expense and investment performance. The investment performance generally will be related to a portfolio of assets backing the underlying business and, consequently, an embedded derivative exists in this case as well. In surplus relief treaties, the two embedded derivatives may substantially offset one another, but a detailed analysis of the agreements would have to be performed to verify that this is indeed the case.

EMBEDDED DERIVATIVE DETERMINATION

The nature of the embedded derivative feature is strongly influenced by the determination of the host contract. DIG Issue B36 does not proscribe a particular type of host contract, although the guidance does imply that the host contract is either the ModCo arrangement (insurance contract) itself or a "debt host." Previously released FAS 133 Implementation

Issue B19 ("DIG Issue B19") provides guidance about how to identify the characteristics of a debt host contract. Such characteristics generally should be based on the stated or implied substantive terms of the hybrid instrument (the ModCo or CFW contract). Those terms may include a fixed-rate, floating-rate, zero-coupon, discount or premium, or some combination thereof. In the absence of stated or implied terms, DIG Issue B19 states, an entity may make its own determination of whether to account for the debt host as a fixed-rate, floating-rate or zero-coupon bond. That determination requires the application of judgment, which is appropriate because the circumstances surrounding each ModCo or CFW contract may be different. In such cases, it is appropriate to consider the features of the contract, the issuer (i.e., ceding company) and the market in which the contract is issued, as well as other factors, in order to determine the characteristics of the debt host contract.

DIG Issue B19 goes on to state, however, that an entity may not express the characteristics of a debt host contract in a manner that would result in identifying an embedded derivative that is not already clearly present in a hybrid instrument. For example, it would be inappropriate to identify a fixed-rate host contract and a fixed-to-floating interest rate swap component in an embedded compound derivative in lieu of identifying a floating-rate host contract.

Once the host contract is determined using these guidelines, the entity must then analyze the embedded derivative feature(s) following the guidance in paragraphs 12 and 13 of Statement 133 to determine whether the economic characteristics and risks of each feature are "clearly and closely related" to the economic characteristics and risks of the host contract. DIG Issue B36 clearly states that the third-party credit risk implicit in the ModCo and CFW contract cannot be "clearly and closely related" to the host contract and must be bifurcated—no matter what the host contract is determined to be.

Additional features in the contract may result in interest rate risk that is also not "clearly and closely related" to the host contract, but this analysis is dependent on the determination of the nature of the host contract. Paragraph 13 of Statement 133 will be particularly relevant to this analysis. Paragraph 13, as amended by Statement 149,

The nature of the embedded derivative feature is strongly influenced by the determination of the host contract.

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requires bifurcation if either of the following conditions exists:

- The hybrid instrument can contractually be settled in such a way that the investor (holder) would not recover substantially all of its initial recorded investment. (We believe the “investor” would be the assuming company in the ModCo or CFW arrangement).
- The embedded derivative meets both of the following conditions: (1) There is a possible future interest rate scenario (even though it may be remote) under which the embedded derivative would at least double the investor’s initial rate of return on the host contract. (2) For each of the possible interest rate scenarios under which the investor’s initial rate of return on the host contract would be doubled, the embedded derivative would at the same time result in a rate of return that is at least twice what otherwise would be the then-current market return (under each of those future interest rate scenarios) for a contract that has the same terms as the host contract and that involves a debtor with a credit quality similar to the issuer’s (ceding company) credit quality at inception.

If as a result of this analysis, interest rate risk is determined to be not “clearly and closely related” to the host contract, then that feature must also be bifurcated with the third-party credit risk feature as part of a “compound embedded derivative” as required by FAS 133 Implementation Issue B15 (“DIG Issue B15”).

The determination of the host contract (insurance host, fixed-rate debt host, floating-rate debt host, etc.) under DIG Issue B19 influences the nature of the embedded derivative. Among the likely results are embedded derivative features that are comparable to total return swaps or to credit default swaps.

A total return swap (TR Swap) is an instrument in which one party agrees to pay the “total return” of specified assets in exchange for another specified cash flow. For a floating rate TR Swap, the other cash flow is based on some floating interest rate, such as LIBOR. For a fixed rate TR Swap, the other cash flow is based on a fixed interest rate. A credit default swap provides for a payment to be made upon certain third party credit events, such as default, credit rating downgrade or debt restructuring. The

buyer of the contract makes periodic payments to a counterparty.

If the analysis in accordance with DIG Issue B19 indicates that the host contract is a loan between the ceding company and the reinsurer, a company may conclude that the embedded derivative is akin to a total return swap. A total return swap further may be viewed as having a floating or fixed rate leg. The assumption is that the reinsurer is swapping out a fixed or variable rate and swapping back the total return on the portfolio.

Alternatively, a company might conclude that the embedded derivative is akin to a credit default swap with credit risk separated out from the other risks, such as interest rate and asset/liability mismatch. The embedded derivative would then be valued in terms of observed changes to the credit spreads of the assets comprising the portfolio as compared to a benchmark interest rate curve over the observation period.

In summary, each company will need to carefully evaluate DIG Issue B19 and paragraphs 12 and 13 of Statement 133 in light of DIG Issue B36 in order to determine the nature of the host contract and the embedded derivative. DIG Issue B36 states that, at a minimum, a credit derivative is always going to have to be bifurcated from all contracts. Whether or not additional interest rate features are also bifurcated will depend on the unique analysis applied to each arrangement. There are a number of issues to be considered, such as the nature of the agreement, including its stated or implied terms, the quality and timing of information available and the nature of the risks inherent in the assets in light of the obligations to policyholders subject to the reinsurance agreement. The analysis will have to carefully consider the facts and circumstances of each treaty or contract, as the approach needs to appropriately address the underlying derivative. The solution should be implemented such that the results can be easily explained, and approval for the approach must be received from both the company’s management and auditors.

OTHER HIGHLIGHTS OF DIG ISSUE B36

Upon the implementation of DIG Issue B36, ceding companies will be allowed a one time

If the analysis in accordance with DIG Issue B19 indicates that the host contract is a loan between the ceding company and the reinsurer, a company may conclude that the embedded derivative is akin to a total return swap.

reclassification of securities from the held-to-maturity and available-for-sale categories into the trading category in the fiscal quarter DIG Issue B36 becomes effective. This FAS 115 “mulligan” is limited to the amount and type of securities related to the embedded derivatives that are being newly accounted for under DIG Issue B36. If the results of the analysis performed to determine the nature of the host contract (in accordance with DIG Issue B19) and the nature of the embedded derivative indicate that the hybrid should be characterized as a floating-rate debt host contract with an embedded total return swap, companies may want to take advantage of this one-time reclassification opportunity. This “mulligan” could provide a substantial offset to potential earnings volatility for the ceding company, since the change in market value of FAS 115 assets classified as trading also flows through the income statement.

In addition to the contracts described in the primer above, DIG Issue B36 also applies to other types of receivables and payables where interest is determined by reference to a pool of fixed-maturity assets or a total-return debt index. For example, an experience refund for a group contract may be determined by reference to the actual investment performance of the assets. Some Immediate Participation Guarantee (IPG) group annuity contracts keep participants’ deposits in an unallocated fund that reflects immediately the actual experience of the contracts, including mortality, expenses and actual investment returns. This sharing of actual investment returns transfers credit risk that is unrelated to the IPG writer, and thus results in the existence of an embedded derivative that is not clearly and closely related to the host contract.

Once the affected contracts are identified, embedded derivatives must be bifurcated and accounted for at fair value. Moreover, given the inherent nature of the embedded derivatives, it would be difficult to satisfy the hedge accounting criteria. Therefore, it would be unlikely that the embedded derivatives could be accounted for as a hedge.

IMPLICATIONS FOR ACTUARIES AND INSURANCE PROFESSIONALS

DIG Issue B36 introduces a number of challenges for actuaries and other insurance professionals. First actuaries will need to work even more closely with investment professionals to properly identify and value the embedded derivatives. Assets supporting the affected treaties will need to be identified. Reinsurance experience refund features will need to be evaluated as they may contain embedded derivatives as well.

Insurance professionals will need to be mindful of the effects of DIG Issue B36 in explaining and analyzing GAAP results, since changes in the fair value of the embedded derivatives will flow through earnings. Moreover, gains and losses from derivatives will be part of the gross profit stream that will impact amortization of certain GAAP items, such as deferred acquisition costs and unearned revenue liabilities. Overall, the financial statements will be more volatile and the explanation of profit emergence patterns will be more complex.

In some cases, a new level of asset/liability modeling, particularly for reinsurers, may be required to determine the value of the

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Useful Links

DIG Issue B36: <http://www.fasb.org/derivatives/issueeb36.shtml>

DIG Issue B15: <http://www.fasb.org/derivatives/issueeb15.shtml>

DIG Issue B19: <http://www.fasb.org/derivatives/issueeb19.shtml>

embedded derivative and the related financial impact.

Offshore reinsurers also may be affected by this new accounting guidance. For those jurisdictions where U.S. GAAP may be used to comply with local statutory reporting requirements, such as Bermuda, DIG Issue B36 impacts will need to be carefully evaluated.

Actuaries in the group insurance or group annuity business will need to evaluate their contracts to determine whether the contracts contain features that are embedded derivatives requiring bifurcation. Again, these actuaries will also need to work with investment professionals closely to determine the proper approach, and be able to explain the increased volatility in their financials.

Pricing actuaries at reinsurance companies will face many challenges as well. When structuring ModCo, CFW treaties or treaties with experience refunds, not only will pricing actuaries need to continue to further consider the creditworthiness of the direct writer seeking reinsurance, but they will also need to evaluate the credit quality of the supporting asset portfolio on a much more detailed basis given the implications on financial statements. A portfolio with plain vanilla treasury bonds may produce an embedded derivative with no value because its inherent credit risk might be viewed as never changing, while a portfolio of lower quality securities, which exposes the reinsurer to asset default risk, may produce a derivative with significant value. Fluctuations in the fair value of the embedded derivatives are now reflected in the income statement, in addition to other risks the reinsurer is taking on, such as mortality and surrender. To minimize the volatility on financial statements, the pricing actuary could structure the treaty so as to minimize the asset default risk, negotiate better quality assets or hedge the risk. The

actuary should consider all these issues, while being mindful of statutory and GAAP risk transfer requirements.

Direct writers looking for reinsurance also will be affected, as the reinsurer may be more focused on the asset quality of the underlying portfolio and will require significantly more data than may have been provided in the past. Pricing actuaries in the group life insurance business or the group annuity business also would need to be more aware of the quality of the underlying assets supporting certain product features, such as the experience refunds that credit actual investment returns, as well as IPG and other contracts in which the actual investment experience is credited to the policyholder account balance.

CONCLUSION

There is a great deal of work to be done to develop an approach for implementing this new accounting guidance, and very little time with which to implement solutions. Companies need to act quickly to understand the issues, analyze their own business situations, develop a plan of attack to understand the nature of the host contracts and the embedded derivatives, determine the fair value of the embedded derivatives, and analyze/explain the results of these solutions. ☐

Glossary of Terms

Embedded Derivative	Derivatives embedded in other instruments. For example, a debt instrument where the interest payments fluctuate with changes in the S&P 500.
Clearly and Closely Related	An embedded derivative is considered to be “clearly and closely related” to a host instrument when the economic characteristics and risks of both are closely aligned. An example is a debt note with interest payments tied to changes in the debtor’s credit rating.
Fair Value	Fair Value is the amount at which an asset (liability) could be bought (incurred) or sold (settled) in a current transaction between willing parties, that is, other than in a forced or liquidation sale. FAS 133 further defines “fair value” in paragraph 540.
Total Return Swap	A total return swap (TR Swap) is a swap in which one party agrees to pay the “total return” of specified assets in return for another cash flow. For a floating rate TR Swap, the other cash flow is based on some floating interest rate, such as LIBOR. For a fixed rate TR SWAP, the other cash flow is based on a fixed interest rate.
Credit Default Swap	A credit default swap provides for a payment to be made upon a third party credit event, such as default, credit rating downgrade or debt restructuring. The buyer of the contract makes periodic payments to a counterparty such as a banker or an insurance company (known as the “writer”).
Insurance Contract Exception	FAS 133 paragraph 10C defines “certain insurance contracts” to be exempt. The exempt contracts are those that compensate the holder only as a result of an identifiable insurable event. Examples include term or health products.



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Investor & Management Expectations of the “Return On Equity” Measure vs. Some Basic Truths of Financial Accounting

by Michelle D. Smith

Editor's Note: A related article is planned for the next issue of The Financial Reporter that will provide a general description of the Embedded Value methodology. The section's Statutory Issues List Serve or GAAP List Serve would be an appropriate forum for discussing the concepts of this article.

1) INTRODUCTION

As pricing and financial reporting actuaries in the U.S. know, there is often a disconnect between the way products are priced and the way business performance is measured once it is already on the books. This is because pricing is typically done by targeting a desired Internal Rate of Return (IRR) based on future statutory earnings adjusted for target surplus (i.e. “distributable earnings”), but business is assessed in shareholder reporting on a GAAP basis, which treats future distributable earnings differently than the pricing actuaries do.

Serious discussion of this dilemma goes back at least 30 years, when Donald Sondergeld published a paper called “*Earnings and the Internal Rate of Return Measurement of Profit*”¹ in the 1974 Transactions. This paper introduced the concept of the “Internal Rate of Return Method of Accounting” or IRRMA—a financial reporting method designed to be consistent with pricing methodology (when pricing to achieve a target IRR), and to produce earnings uniformly in relation to shareholder investment, rather than revenue or gross profits as under GAAP.

Fast forward three decades, and the problems caused by the disconnect between the different accounting systems underlying product development and shareholder reporting are

still with us today. However, this fact is often not appreciated by analysts, shareholders or senior management at many companies. Despite widespread appreciation in the actuarial community that GAAP earnings were never designed to produce a level annual Return on Equity (ROE) if everything turns out as expected, there still seems to be an expectation among other audiences that this is indeed the case. It is often difficult to explain to management and investor audiences why, if you are pricing your products to achieve a certain IRR, annual GAAP ROEs deviate from this IRR if experience emerges as expected in pricing. Because of this expectation, GAAP ROE patterns can give misleading information about the actual performance of business priced at a certain IRR.

Discussion of the shortcomings of GAAP as a shareholder reporting tool continue to this day, almost 30 years after the Sondergeld paper. Several recent articles in *The Financial Reporter* have covered this issue, including John Bevacqua's March 2003 article entitled “GAAP ROE: Exactly How Meaningful Is It?” and Wayne Stuenkel's September 2002 article, “Relationship of IRR to ROI on a Level Term Life Insurance Policy.”

In light of the developments toward international accounting standards and the fact that multinational companies have to deal with financial reporting systems in other countries, it is necessary to take these discussions a step further. It seems important to look beyond U.S. GAAP and statutory accounting and to generalize certain observations to the full universe of “reasonable” financial reporting systems.

This article will first show that embedded value reporting (with discount rate equal to the IRR) is the only financial reporting system that produces a level annual (or other appropriate periodic) ROE measure, if everything turns out as expected. This financial reporting system is basically the modern version of Sondergeld's original IRRMA. To prove this, an interesting relationship between embedded value and the equity and returns of any other reasonable financial reporting system will be presented.



Finally, this article presents an example to illustrate how GAAP and embedded value equity and returns compare when something unexpected happens to the business, and how these financial reporting systems relay different information about this unexpected event.

2) THE ONLY FINANCIAL REPORTING SYSTEM WITH LEVEL ROES

Let us consider the universe of financial reporting systems that satisfy the following two basic conditions:

(1) Earnings under the reporting system

= Cash Flow to Shareholders + Increase in Equity (as defined by the reporting system)

(This is a “common sense” requirement of any system of shareholder reporting), and

(2) Equity at time 0 = initial contribution from shareholders, which we assume is positive.

Distributable Earnings at any distribution date t are defined to be the maximum amounts that are distributable to shareholders, given specified target surplus levels. This is equivalent to statutory earnings in period t , less increase in target surplus from the previous distribution date to time t . For the remainder of this article, we shall assume that cash flow to shareholders is equal to distributable earnings.

“Embedded Value” is defined as the present value of future distributable earnings at a specified discount rate. It should be noted that the embedded value reporting system, with equity equal to embedded value, satisfies conditions (1) and (2). GAAP and statutory accounting also satisfy conditions (1) and (2).

The following relationship, for all earnings distribution dates t , between:

- Equity (E), as defined by ANY financial reporting system satisfying the two basic conditions listed above and
- Embedded Value (EV), calculated using the IRR as the discount rate,

holds when earnings have been as expected in the original product pricing at the IRR. (This assumes that a unique IRR exists.)

THEOREM A

$$E_t - EV_t = \prod_{x=1}^t [(ROE_x - IRR) * E_{x-1} * (1 + IRR)^{(t-x)}]$$

where;

E_t = Equity (under any financial reporting system satisfying conditions (1)-(2)) at time t

EV_t = Embedded Value at time t , using discount rate = IRR

IRR = pricing internal rate of return after target surplus

ROE_x = Return on Equity (under the financial reporting system that defines E) at time x
 = Earnings (under the reporting system that defines E) in period x / E_{x-1} (opening equity)

See Appendix A for a proof of this relationship.

This relationship can be useful in understanding ROE patterns, based on the relationship between equity, as defined by a given financial reporting system, and embedded value. More interestingly, from this equation it is easy to show that, if everything turns out as expected in pricing, and if expected future equity is always non-negative and goes to zero at the end of the projection period, then:

COROLLARY B

The periodic ROEs under any financial reporting system satisfying conditions (1)-(2) are level if, and only if, the financial reporting system is the embedded value reporting system with discount rate = IRR.

See Appendix B (gold insert) for a proof of this corollary. Thus, the task of explaining to others why pricing GAAP ROEs deviate from a level pattern is equivalent to determining why GAAP equity is not equal to embedded value (with discount rate = IRR). The latter may be a simpler problem to solve.

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Similar conclusions may have been drawn using other methodologies in past articles and papers, but perhaps not with a view to generalize beyond United States accounting systems. Interestingly, from a search on “level ROE” in the actuarial library accessible from the SOA Web site, I was also able to reach the conclusion in Corollary B based on a combination of results derived in a 1982 paper by Sondergeld² and a 1988 *Financial Reporter* article by Stephen Strommen³. This conclusion was also reached in Beale⁴.

that this product is issued over three years, with a 10 percent growth rate. Then expected GAAP ROEs on the whole block would remain well below the pricing IRR for many years, looking like this over the first seven calendar years:

Calendar Year	1	2	3	4	5	6	7
ROE	9.9%	10.4%	10.4%	10.3%	10.1%	9.9%	9.7%

3) THE PROBLEM WITH THE GAAP RETURN “MESSAGE”

Given that, in reality, expected (pricing) GAAP ROEs vary by policy duration, the GAAP accounting method seems to present confusing information regarding actual versus expected experience. For example, if a company’s GAAP ROE in a reporting period is lower than its IRR, this could either be due to an expected increasing pattern of GAAP ROEs in the future, or experience being worse than expected. A person looking at the actual GAAP ROEs emerging from an in-force block consisting of a mix of durations has difficulty trying to figure out if the business is performing as expected or not, and even whether he or she is receiving good news or bad news.

If the business is performing exactly as expected, looking at GAAP ROEs alone sends the wrong message to management: that the product is underperforming, when, in fact, it is performing exactly as expected. In contrast, embedded value reporting would clearly tell whether or not the business was performing as expected in pricing. If the discount rate were equal to the IRR, the embedded value return would equal the IRR every year. If, as is normally the case, the embedded value discount rate were lower than the IRR, the embedded value returns would jump above the discount rate in the year of issue and then stay level at the embedded value discount rate thereafter. In both cases, embedded value returns are sending management and shareholders a more accurate message than GAAP ROEs.

Although this has been done many times before, it is still most informative to illustrate these problems using an example. We assume that a universal life product is priced to earn more than 11 percent; the IRR over a 30-year projection period is 11.3 percent. DAC is amortized over a shorter 20-year period, and the expected pattern of GAAP ROEs by policy year is:

In summary, unless a constraint in product design produces level expected ROEs, then actual ROEs do a poor job of telling how the business is performing, compared to expectations. And, as we have seen, if expected ROEs are level, one ends up with the embedded value reporting system (with discount rate = IRR).

4) GAAP VS EMBEDDED VALUE REPORTING WHEN THE UNEXPECTED HAPPENS

Policy Year	1	2	3	4	5	10	15	20	25
ROE	9.9%	10.9%	10.6%	9.8%	9.2%	8.6%	10.0%	14.1%	47.4%

The prior formulae and examples are applicable when everything turns out as expected in pricing. In order to understand how GAAP and embedded value earnings differ when something unexpected happens, we simply need to understand how the unexpected event affects equity under the two financial reporting systems, since both systems see the same cash flow to shareholders emerge in any period.

Obviously, expected GAAP ROEs for this product stay well under the 11.3 percent IRR for quite some time and jump quite dramatically as the DAC balance runs off. Let’s assume

This is best illustrated through an example. Consider a simple single premium deferred

annuity (SPDA) with IRR = 12.3 percent and the following expected GAAP ROE pattern:

The difference between the behavior of GAAP and embedded value earnings is best understood by considering what happens to GAAP equity and embedded

Policy Year	1	2	3	4	5	6	7	8	9	10
ROE	12.2%	13.0%	12.9%	12.6%	12.3%	11.8%	11.5%	11.6%	11.7%	11.8%

If we assume, for simplicity, that the embedded value discount rate is the IRR, then, if everything turned out as expected, EV returns would be 12.3 percent every year and GAAP ROEs would follow the pattern above.

value after the shock. It becomes clear that embedded value is written down considerably more than GAAP equity upon the unexpected extra surrenders. Hence, embedded value returns take a much greater “hit” than does GAAP ROE in the year of the shock.

Now, let us suppose that the actual surrender rate in policy year 4 turns out to be triple what we expected in pricing, but thereafter, everything is as expected in pricing.

This observation reflects the fact that embedded value is written down in the year of this shock for the full impact of lost future distributable earnings due to the extra surrenders. This is true, of course, regardless of the discount rate used to calculate embedded values. In contrast, GAAP equity only partially writes off these lost future earnings in the year of the shock. GAAP equity has capitalized future earnings only to the extent that they are needed to amortize capitalized acquisition expenses under GAAP accounting rules. The rest of the future distributable earnings will fall through the GAAP accounts as they emerge. Hence, GAAP earnings take something of a hit in the year of the unexpected extra surrenders, but defer the rest of the adverse

In such a case, we would see embedded value return drop from its expected level of 12.3 percent, to 8.4 percent in year 4, a reduction in return of almost 400 bps from expected levels. Thereafter, because actual experience returns to expected, embedded value returns will return to the 12.3 percent level.

In contrast, actual GAAP ROE in year 4 drops to 11.3 percent, a drop in return of only 130 bps from the expected level of 12.6 percent. However, all future ROEs (from year 4 onwards), will be below their expected pricing levels, even as experience returns to that expected in pricing. It is informative to compare actual and pricing expected ROEs after this shock, assuming that everything returns to expected afterwards.

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Policy Year	1	2	3	4	5	6	7	8	9	10
Expected ROE	12.2%	13.0%	12.9%	12.6%	12.3%	11.8%	11.5%	11.6%	11.7%	11.8%
Actual ROE	12.2%	13.0%	12.9%	11.3%	11.6%	11.2%	10.9%	11.0%	11.1%	11.2%
ROE “Hit”	0.0%	0.0%	0.0%	1.3%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%

impact into the future, meaning that all future GAAP earnings are impacted by today's unexpected event. We can clearly see the impact on future GAAP earnings of something that happens today in the table above that compares actual and expected GAAP earnings for 10 years.

There are various formulaic relationships that exist between GAAP equity (or equity for other financial reporting systems) and embedded value when experience doesn't turn out as expected in pricing. If you are interested in seeing these and/or their derivations, please contact the author.

5) EMBEDDED VALUE AND GAAP IN PRACTICE

Throughout this article, mention has been made of calculating embedded value for a product line at its IRR. This was done to illustrate one of the main points of this article: that there is a unique financial reporting system with level expected pricing ROEs. In practice, when calculating embedded values for a whole company or block of business, different products have different IRRs and the embedded value is usually calculated at a rate less than the various IRRs. However, the conclusion about the necessary conditions for level ROEs is not altered by this reality. Furthermore, the conclusion drawn in Section 4 about embedded value reporting picking up the full impact of unexpected events or management actions in the period they occur is also not affected by the choice of discount rate.

As for GAAP reporting in practice, management generally does not track GAAP ROE patterns for single tranches of new business issues. However, this was done in the examples used in this article to more readily illustrate the problems that emerge in analyzing GAAP ROEs for a whole block of business with tranches issued in various years.

6) SUMMARY AND CONCLUSIONS

As has been discussed in the actuarial literature for many years, and specifically in several recent issues of *The Financial Reporter*, GAAP returns can send the wrong message to management, shareholders and analysts. There is a disconnect between (i) the way prod-

ucts are priced to target a certain IRR, and (ii) the way that business is measured under GAAP accounting rules once it is on the books. This leads to a disconnect between the expectation of what GAAP ROE is saying versus what it is actually measuring. One of these expectations is that annual GAAP ROEs should be close to the IRR if everything turns out as expected, but this is generally not true.

This article has shown that there is only one financial reporting system that produces a level periodic ROE, and that is the embedded value reporting system with discount rate equal to the IRR. This means that the problem of figuring out why pricing GAAP ROEs deviate from a level pattern is equivalent to the problem of explaining why GAAP equity deviates from embedded value at the IRR.

Through examples, this article has also shown that GAAP accounting allows the impact of events or management actions today to affect all future years' GAAP returns, whereas embedded value reporting would totally account for such events or actions only in the year in which they occur.

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APPENDIX A: PROOF OF THEOREM A

Theorem A

$$E_t - EV_t = \sum_{x=1}^t [(ROE_x - IRR) * E_{x-1} * (1 + IRR)^{(t-x)}]$$

where;

E_t = Equity (under any financial reporting system satisfying conditions (1)-(2)) at time t

EV_t = Embedded Value at time t , using discount rate = IRR

IRR = pricing internal rate of return after target surplus

ROE_x = Return on Equity (under the financial reporting system that defines E) at time x = Earnings (under the reporting system that defines E) in period x / E_{x-1} (opening equity)

Proof:

We assume we have an arbitrary financial reporting system, Y, that satisfies Conditions (1)-(2).

Let us define: YE_t = earnings under financial reporting system Y in period t, and
 E_t = equity at time t under financial reporting system Y,
 DE_t = distributable earnings in period t,
 r = IRR,
 n = end of the projection period.

From Condition 1 and the assumption that cash flow to shareholders = distributable earnings, we have:

$$DE_x = YE_x - [E_x - E_{x-1}] \text{ for all } x$$

Then:

$$\sum_{x=0}^t [DE_x (1+r)^{t-x}] = \sum_{x=0}^t YE_x (1+r)^{t-x} - \sum_{x=0}^t [(E_x - E_{x-1})(1+r)^{t-x}]$$

$$LHS = \sum_{x=0}^t [DE_x (1+r)^{t-x}] = \sum_{x=1}^n [DE_x (1+r)^{t-x}] \text{ (since } r \text{ is the IRR)}$$

$$= EV_t - \text{(by definition of EV)}$$

Now, on the RHS, the Expression $\sum_{x=0}^t [E_x - E_{x-1}] (1+r)^{t-x}$

can be written out in full, reorganized a bit, and easily shown to be equivalent to:

$$= E_t + r \sum_{x=1}^t E_{x-1} (1+r)^{t-x}$$

So now we have:

$$- EV_t = \sum_{x=1}^t YE_x (1+r)^{t-x} - E_t - r \sum_{x=1}^t E_{x-1} (1+r)^{t-x} \text{ [since } YE_0 = 0 \text{ as } E_0 = DE_0 \text{ (Condition 2)]}$$

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Which can be re-written as:

$$E_t - EV_t = \sum_{x=1}^t YE_x * (1+r)^{-x} - r * \sum_{x=1}^t E_{x-1} * (1+r)^{-x}$$

$$= \sum_{x=1}^t \left[(ROE_x - r) * E_{x-1} * (1+r)^{-x} \right]$$

since $ROE_x = YE_x / E_{x-1}$ (by definition of ROE).

APPENDIX B: PROOF OF COROLLARY B

For the following conclusion to hold we must assume that our pricing is such that expected future equity is non-negative and goes to zero at time n, the end of the projection period.

Corollary B: The periodic ROEs under any financial reporting system (satisfying conditions (1)-(2)) are level if, and only if, the financial reporting system is the embedded value reporting system with discount rate = IRR.

Proof: If the ROEs under our arbitrary financial reporting system Y are level, then the expression in Theorem A becomes:

$$E_t - EV_t = (ROE - IRR) * \sum_{x=1}^t E_{x-1} * (1+IRR)^{-(t-x)}$$

Since $E_n = EV_n = 0$ at the end of the projection period and since;

$$\sum_{x=1}^n [E_{x-1} * (1+IRR)^{-(n-x)}] > 0 \text{ (since } E_t \geq 0 \text{ for all } t, \text{ for the pricing run, and } E_0 > 0 \text{ under Condition 2),}$$

then $ROE = IRR$.

Hence RHS of the equation in Theorem A = 0 for all times, t.

Hence $E_t = EV_t$ for all t.

Conversely, if we are using the financial reporting system with discount rate = IRR, then, by definition of earnings under this system, ROE is level and equal to the IRR every year. ☒



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Modeling Variable Annuity Minimum Guaranteed Death Benefits

by Donald A. Skokan

Editor's Note: The section's GAAP List Serve would be an appropriate forum for discussing concepts in this article.

FASB has finalized a Statement of Position (SOP) that includes new guidance about appropriate levels of reserves for minimum guaranteed death benefits (MGDB) common in the variable annuity marketplace. A distinctive and fundamental aspect of the SOP concerns how expected experience is determined. Paragraph 26 states:

"Expected experience should be based on a range of scenarios rather than a single set of best estimate assumptions."

A natural inclination in addressing the SOP is to aggregate Variable Annuity (VA) contracts into a relatively small number of model cells (subsequently referred to as "aggregation" for brevity), so that results can be computed over a large number of scenarios. Indeed, aggregation and modeling are used in a number of actuarial tasks such as pricing, cash flow testing and even GAAP valuations. In terms of forecasting fund values, a properly designed model can produce satisfactory results. But is a model that aggregates contracts into a relatively small number of model cells appropriate—that is, can it produce accurate results—in forecasting MGDB benefits for the SOP? This article examines the impact of aggregating contracts on the MGDB benefit, in light of the requirements of the SOP.

MODELING FOR THE MGDB AMOUNT

When contracts are aggregated into modeling cells, the cell's ability to reflect the true, aggregate MGDB amount may be adversely affected. The conditions leading to this result are systemic for VA products. They include:

a) *Contracts with similar characteristics that are typically aggregated, such as age and sex, can nonetheless show substantial variation in their MGDB component values.*

A prime cause of this phenomenon is the flexibility that VA contracts afford to the

contractholders. For example, each contractholder makes unique investment decisions, which can lead to substantially different fund value development. In addition, contractholders have wide discretion as to the amount and timing of gross considerations and partial withdrawal activity.

b) *It is not uncommon for a VA contract to feature multiple MGDB components, such as a ratchet coupled with a rollup.*

This complexity makes it difficult to construct model cells that can accurately represent the interaction of these components as they occur within each of the contracts included in the cell.

c) *Individual plans sometimes offer contractholders options affecting the MGDB provisions, such as different rollup rates or*

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ratchet periods, and even options to add components, all within the same plan.

In this situation, plan-based model cells will fail to capture key distinctions that exist between contracts in the same plan.

The conditions above produce a difficult environment in which to create model cells that can accurately represent MGDB benefits. The aggregation process may thus introduce shortcomings when:

- a) *Combining contracts in model cells where some contracts have MGDBs in the money and some do not. Problems can occur even where model cells are differentiated by in-the-money-ness* of the underlying contracts.*

Model cells that capture the **current** in-the-money-ness* are of limited value in forecasting future results, as individual contracts will move in and out of the money at different points in the projection period. These differences arise because of the unique allocation each contract makes among available subaccounts and how each subaccount performs under each scenario. In addition, each contract's historical fund values and transactions, upon which the MGDB values may be based, may cause differences in the projected death benefits.

- b) *Combining contracts where the death benefits of the contracts are not all governed by the same component; e.g., ratchet for some, rollup for others, etc.*

Similar to the discussion in the preceding point, creating model cells based on the current governing MGDB component is not sufficient, because the governing component

for a contract is apt to change during the projection period under some of the scenarios.

- c) *Establishing model cells that do not have access to prior transactions (gross considerations and partial withdrawals) or access to prior fund value balances of the underlying contracts of the cells.*

As stated earlier, historical contract values may be the basis for future values of MGDB components. If the model cell doesn't have access to this information, then its ability forecast MGDB amounts is degraded.

- d) *Establishing individual model cells that include contracts with a range of issue dates.*

This situation creates an ambiguous point at which the ratchet or reset component is re-established.

A BIAS RESULTING FROM AGGREGATION IN MGDB MODELING

The difficulties just delineated raise questions about the ability to accurately model the MGDBs of a block of business under all but the most rigorous model construction. This is of particular concern in regard to the SOP for two reasons. The first reason is that the MGDB modeled by combining contracts into cells is likely to be smaller than its seriatim counterpart, due to the maximizing formula employed in virtually all MGDB definitions.

To illustrate how this happens, observe the impact of combining into one model cell the following two contracts with two MGDB components and roughly the same in-the-money status:

Contract	Fund Value	Ratchet Component	Roll-up Component	MGDB Amount
1	45,000	55,000	50,000	55,000
2	40,000	47,000	50,000	50,000
Sum	85,000	-	-	105,000
Model Cell	85,000	102,000	100,000	102,000

* The term "in-the-money-ness" refers to the relationship of the death benefit in relation to the fund value. A contract is considered "in-the-money" to the extent the death benefit exceeds the fund value; the greater the excess, the greater the "in-the-money-ness" of the benefit.

One might argue that the model cell could easily be constructed with the knowledge that the current death benefit of the two contracts is \$105,000, so it would not arrive at the \$102,000 MGDB benefit amount. However, that point loses much of its veracity when one is projecting MGDBs for the model cell into the future, without the benefit of knowing the values from each of its underlying contracts.

Algebraically, a model's bias toward this MGDB understatement is captured in the following equation. The equation is instructive, and the key aspect is its sign, because that clarifies the model's bias. First, though, an explanation of the terms is in order. The equation deals with a model cell composed of three contracts numbered 1, 2 & 3, and an MGDB formula that has 3 components a, b, & c. The variable *2b*, for example, is the "b" component of the MGDB formula for contract #2.

This model cell has been enhanced to capture the aggregate amount of each MGDB component for the contracts included in the cell (e.g., the "b" component of the model cell equals the sum of that value from each contract, *1b + 2b + 3b*). It then applies the MGDB formula to those aggregate components to determine the MGDB amount. This is represented by the left side of the equation. The terms to the right represents the MGDB formula at work individually for each contract.

$$\text{Max} \left[\begin{array}{l} (1a+2a+3a), \\ \text{and} \\ (1b+2b+3b), \\ \text{and} \\ (1c+2c+3c) \end{array} \right] \leq \text{Max} \left[\begin{array}{l} 1a, \\ \text{and} \\ 1b, \\ \text{and} \\ 1c \end{array} \right] + \text{Max} \left[\begin{array}{l} 2a, \\ \text{and} \\ 2b, \\ \text{and} \\ 2c \end{array} \right] \leq \text{Max} \left[\begin{array}{l} 3a, \\ \text{and} \\ 3b, \\ \text{and} \\ 3c \end{array} \right]$$

The model cell will produce representative results when the two sides of the equation are equal; that is, when the sign is "=". In reality there is a negative bias in the model and the sign will often be "<". Why? Let's assume that component "b" governs the model cell's MGDB amount. Equality, then, can only be achieved if each contract is also governed by component "b". For any contract included in the model cell whose MGDB amount is governed by either component "a" or "c", the difference between its governing component and its "b" component creates a deficiency in the model cell in relation to the sum of the individual contracts.

This situation may be illustrated with the simple example above. The governing component of the model cell is the Ratchet component, while contract #2's governing component is Roll-up. The \$3,000 difference between #2's Roll-up and Ratchet components is the amount of deficiency in the model cell.

THE EFFECT OF AGGREGATION ON NET-AMOUNT-AT-RISK

The second concern in regard to the SOP is the error that aggregation may cause on the excess of the MGDB over the fund value; i.e., the net-amount-at-risk (NAR). This error ultimately translates into an error in the reserve. When there is a shortcoming in the model cell's MGDB amount, there is a greater shortcoming in NAR. This can be observed by examining the NARs from the example in the preceding section:

Contract	Fund Value	MGDB Amount	NAR
1	45,000	55,000	10,000
2	40,000	50,000	10,000
Sum	85,000	105,000	20,000
Model Cell	85,000	102,000	17,000
Model vs. Seriatim	-	-3%	-15%

Moving beyond that simple example, the NAR deficiency can be computed for various combinations of: a) the model cell's understatement of the MGDB amount in relation to a seriatim calculation; and b) the true in-the-moneyness of the MGDB benefit. The rates of NAR deficiency in the table are established by the formula: $(\text{Modeled NAR} / \text{Seriatim NAR} - 1)$, where the Seriatim NAR is based on a death benefit computed as $DB = FV \times (1 + \text{In-the-Money-Ratio})$ and the Model NAR is based on $DB' = DB \times (1 + \text{MGDB Deficiency})$.

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NAR Deficiency

MGDB Deficiency	In-The-Money Ratio			
	+10%	+20%	+30%	NAR+40%
-1.0%	-11%	-6%	-4%	-4%
-3.0	-33%	-18%	-13%	-11%
-5.0%	-55%	-30%	-22%	-18%

Any inaccuracy in the NAR has a direct impact on the SOP calculation. In fact, a deficiency in the NAR (measured in percentages) translates into a similar deficiency in the MGDB Reserve computed under the SOP. Thus, it would appear that model results similar to those in the preceding table should be a cause of concern in regard to the adequacy of the MGDB Reserve. This situation is important because the reserve is expected to be material for many VA writers.



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MODEL VALIDATION

Based on the potential errors discussed above, a rigorous validation process is appropriate. The focus of the validation should be on the MGDB amounts from the model and how they compare against the results on a seriatim

basis. These comparisons should be made for selected scenarios of varying volatility and direction. Another key point is that such comparisons should be made, not only as of the model creation date, but also for several points in the projection period. Finally, comprehensive seriatim results are important to establish a credible baseline for the comparisons.

CONCLUSIONS

Modeling to produce representative MGDB amounts is challenging, due to the complexity and basic nature of MGDB formulas, as well as the flexibility inherent in Variable Annuity contracts. Aggregating contracts into cells is likely to introduce a bias toward understatement of the MGDB amounts. Even small understatements of the MGDBs can lead to a material deficiency of the NAR amounts, and result in a correspondingly deficient MGDB reserve under the SOP.

Model validation of MGDB amounts needs to be rigorous, because the margin of acceptable model error is small. In this environment, modeled results should be compared against comprehensive seriatim results at several points in the projection period, under multiple scenarios.

In general, aggregating contracts facilitates analysis in a multi-scenario environment, which provides insights that may be difficult to obtain otherwise. However, the SOP's focus on MGDBs and the likely materiality of the MGDB reserves create a great challenge when aggregating contracts with MGDBs into cells. ☒

<p>Thank You, Speakers!</p> <p>The section would like to recognize and express its gratitude to the following persons who were speakers at sessions sponsored by the Financial Reporting Section at the May Spring Meeting in Washington, D.C. You make a difference!</p> <p>Bradley E. Barks Morris W. Chambers Chiu-Cheng Chang Errol Cramer Francis de Regnacourt</p>	<p>John O. Esch Geoffrey Henry Hancock Ronald J. Harasym William C. Hines Michael A. Hughes Steve Jean Novian E. Junus Daniel J. Kunesh Kenneth A. LaSorella Emma McWilliam Esther H. Milnes John W. Morris Jason A. Morton Hubert B. Mueller John O. Nigh Mark D. Peavy Mike Pickens</p>	<p>Hank Prybylski Robert L. Riegel David Y. Rogers Francis P. Sabatini Joel S. Salomon Carol F. Salomone Steven I. Schreiber Jose D. Siberon Vincent Y.Y. Tsang Therese M. Vaughan Deborah Whitmore Robert W. Wilson Timothy E. Hill Ari Joseph Lindner Robert P. Stone Alastair G. Longley-Cook ☒</p>
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Appendix

Summary of Responses to Section Survey: from Chair's Corner on page 3

482 Survey Respondents

Level of Interest

1 = Do Not Support

5 = Strongly Support

	1	2	3	4	5	Average	Stand Dev	1's & 2's	4's & 5's
1. Seminar									
a. Joint Seminar with AICPA	29	74	169	133	56	3.25	57	103	189
b. IAS	21	57	169	163	56	3.38	68	78	219
c. Implementing Actuarial Guidelines	8	30	101	216	111	3.84	82	38	327
d. Financial Reporting Implications of the CSO 2001 Table	24	50	124	158	114	3.61	55	74	272
e. Advanced DAC Issues	16	40	118	181	114	3.72	66	56	295
f. Financial Projections	10	24	95	203	136	3.92	80	34	339
g. Impact of Sarbanes-Oxley on the Financial Reporting Actuary	18	56	166	148	78	3.45	62	74	226
	28	33	92	202	333	3.60			
2. Webcasts									
a. GAAP Issues	19	39	103	190	113	3.73	68	58	303
b. New SOP for Non Traditional Life Insurance Products	35	60	138	161	69	3.37	54	95	230
c. ModCo Reinsurance & SFAS 133	30	65	189	114	61	3.24	62	95	175
d. CARVM Considerations for \$ for \$ Partial Withdrawals	45	70	159	121	65	3.20	47	115	186
e. Issues relating to Variable Product guarantees	45	57	125	134	100	3.41	40	102	234
f. Regulatory Updates	21	33	137	174	95	3.63	66	54	269
g. Value Based Measures	27	71	155	143	65	3.32	55	98	208
h. IAS	34	80	184	116	42	3.11	61	114	158
i. Mergers & Acquisitions	58	89	176	99	38	2.93	53	147	137
	37	56	303	252	373	3.33			
3. Research									
a. Financial Statement Disclosure Practices	20	48	161	182	52	3.43	73	68	234
b. Annuitant Mortality Trends	30	83	169	129	54	3.20	56	113	183
c. Scenario Generation	23	67	150	161	63	3.38	60	90	224
	33	76	333	303	202	3.31			