SOCIETY OF ACTUARIES

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Actuarial Analysis of Different Interpretations of SOP 03-1

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Introduction

This article analyzes two common interpretations of SOP 03-1 in determining the guaranteed minimum death benefit (GMDB) liability in a variable annuity contract, and it analyzes the resulting impact on the initial GMDB reserve and on the volatility of GAAP earnings as actual experience emerges. This analysis could be applied to the guaranteed minimum income benefit (GMIB), guaranteed minimum accumulation benefit (GMAB), guaranteed minimum withdrawal benefit (GMWB) and other guaranteed benefits in a variable annuity contract that are subject to SOP 03-1, and the conclusions would be similar.

Background

For the GMDB reserve, SOP 03-1 discusses calculating a benefit ratio (BR), which is defined as:

$$BR = (1) / (2)$$

where (1) = present value of total expected excess death benefit payments

(2) = present value of total expected assessments

SOP 03-1 goes further and stipulates that the BR should be determined using expected experience, and expected experience should be based on a "range of scenarios rather than a single set of best estimate assumptions." Most companies have interpreted this to mean generating scenarios stochastically. Since the GMDB volatility is mainly driven by the volatility in separate account returns, the stochastic scenarios are derived by projecting separate account returns stochastically.

It is at this point where companies deviate in their interpretation of SOP 03-1. The two common interpretations are as follows:

→**Interpretation 1:**

a. Stochastically generate separate account returns and for each scenario, calculate the present value of excess death benefit payments.

b. Take the mean of the distribution of the present value of excess death-benefit payments. Call this E(X).

c. Calculate the present value of expected total assessments, either deterministically using a long-term average separate account return, or as the mean of the distribution of the present value of total assessments using the stochastic scenarios. Call this E(Y).

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Chairperson's Corner

Tom Nace

2005 – A Year of Transition

This is my first article as chairperson for the Financial Reporting Section, having taken over that role as of the annual meeting. However, this is far from my first article for *The Financial Reporter*. In a former life, I was the editor for this newsletter. More recently, I served as a member of the Financial Reporting section council. So for me, 2005 is going to be a year of transition, as I take on the challenges of being section chairperson. I welcome the opportunity, and I am sure that my prior experiences with the newsletter and the section council have prepared me well to take on the responsibilities that lie ahead.

At this time I would like to thank Mark Freedman, the former section chairperson, for his time and leadership over the last year. Mark did a lot for our section, and I personally enjoyed working with him. I appreciate the opportunities he provided me as part of transitioning the responsibilities of section chairperson.

In a much bigger way, 2005 is also going to be a year of transition for our section and for the SOA as well. As many of you have probably heard, the SOA has adopted a new strategic plan, which will have a major impact on how the SOA is organized and also on the sections' overall responsibilities. One of my major goals for this year is to guide our section through this transition of responsibilities and also to communicate to our members, through this newsletter, the changes and how they will impact our section.

This first article will provide just a little background and also some of the steps taken so far by our section to address the reorganization.

Background

The SOA strategic plan document can be found on the SOA Web site, *http://www.soa.org/ccm/cms-service/stream/asset/?asset_id=8015079&g11n*. In effect, the thrust of the strategic plan is to improve the way in which the SOA provides support and services to its members and also to expand and strengthen the recognition of the actuarial profession.

One of the key principles recognized in the development of the new strategic plan is the unique advantage that sections have had in connecting with their members and responding to the section members' needs. As a result, one of the goals of the reorganization became obvious – not only is it important to maintain the grass-roots connection that the sections have developed over the years with their members, but it would be very advantageous to capitalize on this connection and expand the responsibilities of the sections under the reorganization.

One of the major byproducts of this initiative is to eliminate the practice areas and to have the sections absorb the responsibilities of the practice areas. Another byproduct of the reorganization is increased communications between the section councils and the Board of Governors. Also, all of the sections will be looking at the way in which they carry out their existing responsibilities to see if these processes can be improved. Increased communication amongst the various section councils will be facilitated by several meetings of the council chairs throughout the year.

Steps to Address the Reorganization

So how will we as a section determine what needs to be done in order to take on these new responsibilities? The first step in the process was to develop a transition plan, which will soon be posted on the Financial Reporting Section's Web site. In this document, we have defined various teams, each headed by a section council member, who will be responsible for various aspects of the transition.

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The section's officers and the team coordinators are as listed below:

Section Role	*Coucil Member*
Chair	Tom Nace
Vice-Chair	Darin Zimmerman
Treasurer	Richard Browne
Secretary and Web Liaison	Kerry Krantz
Membership Value Team Coordinator	Yiji Starr
Communications & Publications Team Coord.	Tom Nace
Continuing Education Team Coordinator	Barbara Snyder
Basic Education Team Coordinator	Darin Zimmerman
Research Team Coordinator	Henry Siegel
Marketplace Relevance Team Coordinator	Howard Rosen
Professional Community Team Coordinator	Dan Kunesh

The goals of the Web liaison will be to review the Financial Reporting Section's Web site and to improve the level of information that is provided, as well to maintain the site by keeping relevant information up to date.

The purpose of the Membership Value Team is to focus on providing a sense of community for an area of practice or interest. Potential activities may involve member outreach, member research and volunteer management.

The Communications and Publications Team will focus on developing and identifying a publishing plan for section issues. This will encompass all media, including the newsletter, the Web site, blast emails, etc. The team will also develop a plan for communications with the Board of Governors.

The purpose of the Continuing Education Team is to identify and develop content for continuing education programs, including meetings.

The Basic Education Team will provide input into the basic education process, particularly reviewing the examination syllabus to make sure that critical financial reporting topics are addressed.

The Research Team will be responsible for identifying and overseeing research initiatives, as well as monitoring the experience studies undertaken by other sections.

The purpose of the Marketplace Relevance Team is to focus on advocating externally for actuaries who share an industry, type of employer or interest. Team activities may include: promotion/marketing, career encouragement, market research, surveys of practices, etc.

The Professional Community Team will attempt to establish and maintain external relationships with other (non-actuarial) organizations. Team activities may include: international relations (global actuarial community), academic relations, etc.

We are still in the process of defining the specific tasks for each team that will need to be accomplished in order to transition to our new responsibilities.

Additional resources, over and above the section council, definitely will be needed once we have decided on all that needs to be done. So we will be recruiting "friends of the council" to assist the council members in carrying out their objectives. These "friends" will not be section council members, but will support the council members by heading up small working groups or taking on specific task assignments and then reporting back to the council member who is that team's coordinator.

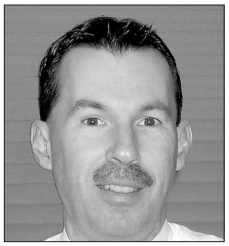
The Future

In future articles, I will provide more details in terms of specific activities our section is taking on and communicate to you the status of the transition.

In addition to the major changes discussed above, this year we will continue to provide the high level of support to various activities as we have done so well in the past, such as continuing education seminars, webcasts, financial reporting sessions at the spring and annual meetings and the newsletter, to name a few.

We will be soliciting member feedback during the year, but, in the meantime, if anyone has any suggestions for ways in which the section can better serve the members, please let me or any member of the council know.

There are a lot of challenges ahead of us in 2005, but I feel confident that with your support we can transition our section – and the Society – to a stronger, more efficient organization for many years to come.



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d. The benefit ratio is then:

$$BR1 = E(X) / E(Y).$$

→**Interpretation 2:**

a. Stochastically generate separate account returns and, for each scenario, calculate:

i. X = present value of excess death benefit payments

ii. Y = present value of total assessments

iii. X/Y = benefit ratio for the given scenario

b. The mean of the distribution of these benefit ratios is then

$$BR_2 = E (X/Y).$$

Analysis

The key question we shall analyze is the comparison of BR_1 with BR_2.

→**Theorem**

$$BR_2 > BR_1$$

→**Proof**

Define the random variables:

X = present value of excess death-benefit payments
Y = present value of total assessments

Note that X and Y are positive random variables and negatively correlated, i.e., high values of excess death benefit payments are associated with low fund values and correspondingly low total assessments.

If we set Z = 1/Y, it follows that X and Z are positively correlated:

$$O < COV(X,Z) = E (XZ) – E (X) * E (Z).$$

which implies that:

$$E (XZ) > E (X) * E (Z)$$
$$\text{i.e., } E (X/Y) > E (X) * E (Z).$$

Since the function g(y) = 1/y is convex (i.e., it has a positive second derivative), it follows by Jensen's inequality that:

$$E (Z) = E [g(Y)] > g [E(Y)] = 1/E (Y)$$
$$\text{i.e., } E (X/Y) > E (X)$$
$$E (Y)$$
$$\text{i.e., } BR_2 > BR_1.$$

Implications

In determining the initial SOP 03-1 reserves for GMDB, the benefit ratio is determined from contract issue, using historical actual excess death-benefit payments and assessments, together with projected excess death benefit payments and assessments. The benefit ratio is then determined using either Interpretation 1 or Interpretation 2.

Once the benefit ratio BR is determined, the opening SOP 03-1 reserves are calculated retrospectively by the formula:

$$(1) – (2)$$

where (1) = accumulated value of BR x (historical assessments)
(2) = accumulated value of historical excess death-benefit payments.

It follows then that the opening SOP 03-1 reserves are lower under Interpretation 1 than Interpretation 2. The magnitude of the difference is given by the formula:

$$\text{accumulated value of } (BR_2 – BR_1) \text{ x (historical assessments).}$$

Impact

The impact of the two interpretations has been analyzed based on the following simplified example:

- Male age 45, 75-80 Basic Table ultimate mortality
- Initial deposit of $1,000,000 and annual deposits thereafter of $10,000
- GMDB benefit based on the roll-up method using a 5 percent guaranteed accumulation rate
- Equity returns generated using a normal distribution with a mean of 9 percent and standard deviation of 20 percent
- Net investment assessment of 100 basis points, net expense assessment of 35 basis points and mortality assessment of 15 basis points
- Surrender charges of 7 percent in year one and decreasing by 1 percent each year to zero in year eight and after
- Lapse rates are level 5 percent each year with a spike of 10 percent in year eight when the surrender charge goes to zero
- 8 percent discount rate

Based on 250 stochastic scenarios, the initial benefit ratio is 1.9 percent under Interpretation 1 and 3.2 percent under Interpretation 2, i.e., the initial benefit ratio under Interpretation 2 is 68 percent higher than under Interpretation 1.

In this simplified example, the end of the year expected retrospective GMDB reserve under Interpretation 1 is equal to $167, which is calculated as:

$$BR_1\text{*(mean total revenue)*(1+discount rate) – (mean excess death benefit)}$$

$$\text{i.e. } 1.9\%\text{*(mean total revenue)*(1.08) – (mean excess death benefit).}$$

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New Editor Needed for *The Financial Reporter*

I am now into my third and final year as editor of *The Financial Reporter*. Now is the ideal time to find a successor. Finding a successor now would allow him or her to work with me on a few issues and gain some knowledge, experience and confidence before taking the reins.

Every editor brings different strengths to the position, which makes it very desirable to get a new editor periodically. Different editors undoubtedly approach the task differently. If you are willing to consider being the next editor, please call me at (765) 477-3220, and we can discuss what is involved. I am proof that the editor does not need exhaustive knowledge and does not need to be a consultant or belong to a large company.

If you think of someone who might be a good editor, please give that person a call and encourage him or her to consider the position and contact me. The section newsletters are one of the strengths of the SOA, and it is important that our section finds a good editor for the next three years. I hope that my phone will be ringing soon.

— Jerry

>> *Actuarial Analysis of SOP 03-1 from previous page*

This assumes revenues are collected at the beginning of the year and benefits are paid at the end of the year.

The same reserve under Interpretation 2 is equal to $383, which is more than twice as large as the reserve under Interpretation 1.

Correct Methodology?

In general, if the use of different methodologies gives relatively close results, the issue of which is the correct one to use is more of an academic discussion. When the results can be significantly different, as shown in our simplified example, then the choice of methodology has important financial implications.

To answer the question as to which is the "correct" methodology, one needs to go back to fundamental actuarial and reserving principles and try to understand what is the underlying risk that we are evaluating.

The basic deterministic prospective reserve formula states that the reserve at any duration equals:

(APV of future benefits) – (APV of future assessments),

where APV = actuarial present value.

A scenario-based or stochastic prospective reserve formula is similar, except that the above formula is calculated for each scenario or stochastically generated variable.

Interpretation 1 is appropriate when the distribution of future benefits is uncorrelated with the distribution of future assessments. An example of this would be the typical situation in stochastic DAC unlocking methodology. Stochastic DAC unlocking formulas recognize that future margins can fluctuate with different market returns. However, future deferrals (if there are any) are generally not impacted in the same way. Interpretation 1 would thus capture the underlying risk obligation and appropriate DAC balance to hold, and would not provide materially different results from Interpretation 2.

The same is not the case for the GMDB reserve. Here, the distribution of future excess death-benefit payments is negatively correlated with the distribution of future assessments, i.e., equity return scenarios resulting in high excess death-benefit payments produce low assessments from the depressed fund balances. In fact, it is this very dependence between the excess death-benefit payments and total assessments that makes this product offering so risky. Interpretation 1 completely ignores this dependence and thus grossly understates the benefit ratio, while Interpretation 2 correctly recognizes and reserves for this dependency relationship.

Concluding Remarks

The authors hope that this article will generate further analysis and reflection on not just GMDB reserving under SOP 03-1, but also reserving for similar guaranteed benefits like GMIB, GMWB, GMAB, etc. In all these instances, the reserving formula shows dependence between future benefits and future assessments.

This article also has implications on unlocking methodologies under SOP 03-1. Interpretation 2, without any modifications, could produce greater volatility in earnings from the unlocking process than Interpretation 1. While Interpretation 2 more correctly captures the true risk of the GMDB product, it may make sense to incorporate it with some kind of corridor approach (similar to stochastic DAC unlocking methodologies) to avoid short-term fluctuations in earnings due to normal market volatility. $

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