The Relationship of Mortality Projections

and the Underlying Mortality Tables Used

by Larry Warren

INTRODUCTION

The 1975-80 select/ultimate mortality table has continued to serve the actuarial profession very effectively over the decades. Scaling factors were updated and minor adjustments were made as an attempt to keep this table current. All prototypes, however, need to be re-evaluated from time to time in order to ensure appropriateness and accuracy. Changes in lifestyles, medical advances, new underwriting requirements and risk classifications, etc. can effect mortality patterns and need to be recognized.

This paper will show that the result of using the 1975-80 select/ultimate table, as opposed to the more modern 1990-95 select/ultimate table, can be a significant understatement of future mortality and hence anticipated profits may prove to be illusory.

Projecting future mortality has been referred to as an art, as well as a science. Mortality projections/assumptions are used in many situations and for many different purposes, from calculating profit margins to demonstrating company solvency. Some examples are:
• Pricing new products
• Cash flow testing

• Analysis of reinsurance costs (e.g. reinsurance premiums vs. future expected mortality)

• Self-support testing (under the NAIC model illustration Regulation, etc.)

• Reserve adequacy testing

• Valuing inforce blocks of business.

The development of mortality projections/assumptions typically takes into consideration company mortality experience, industry mortality experience or a combination of both. Actuaries may include different exposure periods in their analysis, depending on the purpose of the assumptions being developed.

The pricing actuary, when establishing a mortality assumption for developing new products, would begin with the mortality experience of recently issued policies of a particular type of product. They would then make adjustments for any factors that may impact future mortality, including possible changes in new underwriting requirements, average face amount or persistency. The appropriate mortality

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Articles Needed for the News

Your help and participation are needed and welcomed. All articles will include a byline to give you full credit for your effort. *Product Matters!* is pleased to publish articles in a second language if a translation is provided by the author. For those of you interested in working on the News, several associate editors are needed. If you would like to submit an article or be an associate editor, please call David Rains, editor, at (704) 344-2700.

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Preferred Format

In order to efficiently handle articles, 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. We are able to convert most PC-compatible software packages. Headlines are typed upper and lower case. Please use a 10 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 justi-fied. 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.

Please send a hard copy of the article to:

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Thank you for your help.

Comments from the Chair

Greetings!

by Mary J. Bahna-Nolan

Can you believe that this year's Annual Meeting will mark our 20th anniversary as a section? The Council is preparing some fun and exciting things to help celebrate the occasion, including a Call for Papers which will include a monetary award (not to mention the prestige) to the winner(s). More information regarding this and other events will be sent to you later in the year. We are also considering funding a major research effort and welcome your comments on topics you feel need more focus, attention and study.

2002 is definitely proving to be a busy year for the Section Council. We began the year developing sessions and recruiting for the spring meeting in May. I would like to thank Kevin Howard for helping to put together such a strong program for Colorado Springs. On the second day in Colorado Springs, we had a luncheon and held a brief business meeting where we offered members the opportunity to network and share ideas with each other.

In June, we held both the Tying Together Profitability Measures and the second Product Development Actuary Symposium. Preliminary reports suggest both were extremely successful. Hopefully the 150 attendees agree that both the seminar and the symposium provided a great opportunity for learning and networking. I would like to thank Noel Abkemeier, Duncan Briggs and Michelle Smith for their planning and participation in the seminar. I would also like to thank Kevin Howard, Nancy Kenneally, Al Klein, Jay Jaffe, Maria Thompson and Tom Bakos for all their efforts in developing and recruiting for the symposium program. I would also like to thank all the speakers who participated in the symposium. A special thanks goes to Mike Kaster and Tom Streiff who stepped in a gave an excellent keynote presentation on the state of the industry and role of the product development actuary after the speaker we initially recruited cancelled one week prior to the symposium.

We also had an exciting opportunity to take the Product Development Symposium concept overseas. Jay Jaffe and Allen Klein and I, along with some individuals from the Faculty and Institute of Actuaries (UK),conducted presentations to our actuarial colleagues in Schenzhen, China, Seoul, South Korea, Taipei, Taiwan and Singapore. The seminars provided us an opportunity to compare and contrast product and pricing issues, investment and regulatory hurdles, mortality, marketing and distribution challenges as well as just networking with our peers in other countries. By all accounts, the seminars were very successful. We are honored to have been able to bring this program to our membership overseas and to provide the opportunity for our overseas members to receive professional development (PD) credit without having to travel to North America. A special thanks goes to Pat Kum and Sarah Hui of the SOA's Joint Regional Committee in Hong Kong who worked for months putting the programs together. A more detailed article summarizing this adventure will appear in our next newsletter.

In addition to the above, we are also busy finalizing the recruiting for the annual meeting in Boston. We have put together several sessions which we will present using a seminar format centered around a few central themes. We will also be sponsoring a breakfast with a speaker who will address product development in another financial services industry. It looks to be a very rewarding and educational session. I hope to see many of you there!

As you can see, the Council continues to stay busy developing educational programs for our membership, but we are only the beginning of the cycle. To be most effective, we need volunteers. I thank all of you that have generously responded to the blast e-mails requesting speakers and those of you that have generously donated your time. We had a difficult time finding members to run

> We are honored to have been able to bring this program to our membership overseas and to provide the opportunity for our overseas members to receive PD credit without having to travel to North America.

experience, therefore, would be limited to the early durations of newer products, which would have most likely been issued using underwriting guidelines/ requirements similar to what is currently used or will be used in the near future.

The valuation actuary, when performing cash flow testing, reserve adequacy testing, valuing an inforce block of business (possibly for sale or acquisition), etc., would begin with the mortality experience of policies issued over a longer time frame. These policies may have been issued over a period of 10 to 20 or more years, which would be more representative of the company's entire inforce business.

The reinsurance actuary, whether from the ceding company perspective (analyzing reinsurance quotes by comparing them with future expected mortality), or the assuming company perspective (developing a reinsurance quote that properly reflects future expected mortality) may need both viewpoints. They would be interested in mortality experience of recently issued policies in reinsuring new business, but in mortality experience of policies issued "many" years ago in reinsuring inforce business.

II. GENERAL APPROACH

For our demonstration, we started with a simple model using the assumption that a $10,000,000 face amount was issued each year for each issue age (25, 35, 45, and 55) and experiencing Linton "B" lapse rates (20 percent, 12 percent, 10 percent, 8.8percent, 8percent, etc.) We also formed a **composite issue** age by assuming the distribution of face amount by age was 15 percent, 35 percent, 35 percent, and 15 percent for issue ages 25, 35, 45, and 55 respectively.

We used the model described above to calculate actual to expected mortality ratios for policies in particular durations (e.g. 1st three or 1st five policy years). These ratios were calculated by assuming an arbitrary amount of death claims for **actual mortality claims experience** and applying the qx's of the 1975-80 and the 1990-95 select/ultimate mortality tables to these particular policies to obtain the **expected mortality claims experience**. Future mortality claims would be projected over 20 years by applying the actual to expected mortality ratios previously calculated, to the same mortality table that the actual/ expected mortality ratio was based on.

We used this model to calculate actual to expected mortality ratios (for each mortality table) for policies in their **first three policy years**. Next we calculated the 20-year present value of future claims (for **a single year of issue**, representing new business) using the qx's of each mortality table separately. That is, the actual to expected mortality ratio obtained by using the 1975-80 mortality table was applied to the 1975-80 mortality table in calculating the 20 year present value of claims, and analogously for the 1990-95 mortality table.

We then repeated this process using the **first five policy years** to see if the results would differ significantly. We also used this model to calculate actual to expected mortality ratios (for each mortality table) for inforce blocks represented by policies in later durations. We then similarly calculated the 20-year present value of future claims.

III. RESULTS

It was shown that, where the actual to expected mortality ratios were based on mortality experience of the first three policy years, the 1975-80 table produces a present value of future claims **(male composite)** that are **13 percent lower** than what would be obtained by the 1990-95 mortality table. A reduction was seen at each issue age in our test, but varied significantly by issue age as shown on the next page.

> The appropriate mortality experience, therefore, would be limited to the early durations of newer products…

Issue Age	25	35	45	55	Overall
Percent Lower	32%	14%	22%	2%	13%

The results for females were similar but not as extreme. The present value of future claims (**female composite**) are **10 percent lower** when using the 1975-80 table, as opposed to, using the more recent 1990-95 table.

Surprisingly enough our analysis showed that even if the actual to expected mortality ratios were based on the mortality experience of the first five policy years, the above relationships would be similar. It was also shown that for inforce blocks this relationship still holds, but is less dramatic.

It became clear that the 1975-80 table generally produced mortality projections considerably lower than the more recent 1990-95 table. To gain insights into the significance of the mortality differentials between these tables, we sought to determine what **future mortality improvement** factors might recreate the significant decrease in mortality.

We developed a simple model to calculate the reduction in the present value of future claims over 20 years based on a single year of issue (assuming Linton B lapses and a discount rate of 6 percent) resulting from annual mortality improvement (reduction) factors for **all** 20 years. This analysis was done for ages 25 and 55, male and female and both mortality tables (1975-80 and 1990-95).

The results showed that a 1.0% annual improvement factor over **all** 20 years (a somewhat aggressive assumption) produces a decrease in the present value of future claims ranging from 7 percent to 10 percent. Further, a 1.5 percent annual improvement factor (a very aggressive assumption) produces a decrease ranging from **10 percent to 14 percent.**
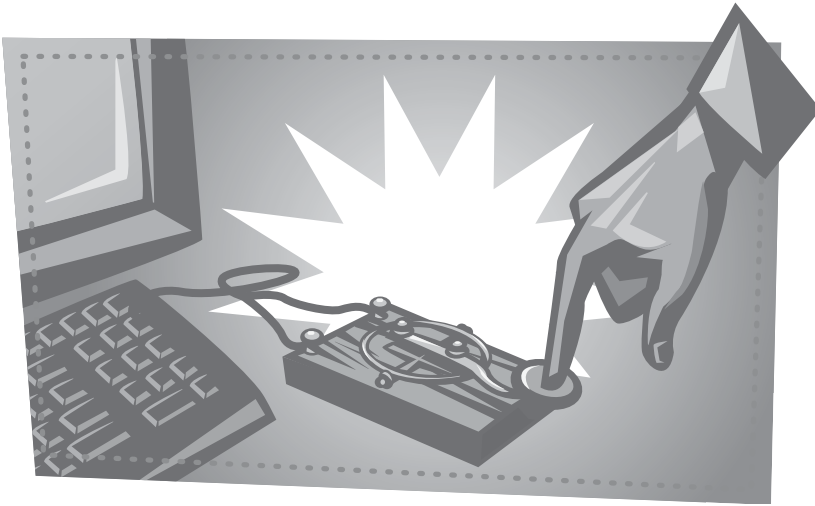
IV. Observations and Conclusions

The relationship of mortality projections and the underlying mortality tables turns out to be quite significant. The majority of companies continue to use the 1975-80 select/ ultimate mortality table. **In making the decision to utilize the 1975-80 select/ultimate mortality table, (as opposed to the 1990-95 select/ ultimate mortality table) the actuary may unwittingly be taking an aggressive posture when it comes to projecting future claims.** As we demonstrated for many issue ages, the decrease in the present value of projected claims resulting from this decision is often greater than the decrease in the present value of projected claims resulting from using aggressive mortality improvement factors.

This phenomenon results from the fact that the slope of the 1990-95 table is higher than that of the 1975-80 table (i.e. in the early years the ratio of the qx's of the 1990-95 table to the 1975-80 table are lower than they are in the later years.) Each of these tables was based on the Society of Actuaries Intercompany mortality study on Standard Ordinary issues in the United States. The 1990-95 table, in addition to being a much more recent table, was based on data where the total dollar amount of exposure was $4.1 trillion for males, and $1.6 trillion for females (more than double that of the earlier 1975-80 table and hence, should have greater

As we demonstrated, for many issue ages, the decrease in the present value of projected claims resulting from this decision is often greater than the decrease in the present value of projected claims resulting from using aggressive mortality improvement factors.

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credibility). It should be noted that the 1990-95 table was developed with selection factors for 25 years with an emphasis of fit over smoothness, while the 1975-80 table was developed with selection factors for 15 years with an emphasis of smoothness over fit.

Companies with relatively low average issue ages (e.g. issue ages 25 – 45) that are still using the 1975-80 select/ultimate mortality table, should be especially careful in setting their mortality assumptions. If actual mortality turns out to be better reflected by the 1990-95 table (which is very likely), they run the risk of significantly understating future claims.

Certain State Regulations dealing with self-support testing and valuation (e.g. Regulation XXX) prohibit the use of mortality improvement factors prospectively. **Since we have shown that using the 1975-80 mortality table is often similar to using the 1990-95 table with aggressive mortality improvement factors, it is not beyond comprehension that state regulators may soon consider the need to** *require* **the use of the 1990-95 mortality table.**

Based on a recent survey conducted by Tillinghast-Towers Perrin (The 2000 Pricing Survey of Individual Life and Annuity Products) covering 22 mutual companies and 38 stock companies, very few companies include future mortality improvement when calculating expected mortality in product pricing. **Therefore since in general, companies believe it prudent <u>not</u> to reflect future mortality improvement, it is especially important that they fully analyze their choice in selecting the underlying mortality table used in their profit studies and mortality projections.** In addition, adjustments and modifications to existing tables may be necessary (e.g. there is an AIDS "hump" in young male middle duration mortality reflected in the 1990-95 mortality table which is probably inappropriate in today's climate of fluid-tested underwriting.)

In order to meet competition, many companies (direct writers as well as reinsurers) have reduced profit margins. Some may have even liberalized (lowered) their mortality assumptions to offset this reduction to profit margin. This increases the likelihood of adverse mortality deviations. **In this business environment the additional vulnerability caused by using a possibly inappropriate mortality table may be untenable.**

Mortality studies are becoming less and less rigorous because it is more difficult to get credible experience. This results from the fact that over recent years new underwriting requirements and many differentiated risk classifications have emerged (preferred, super-preferred, preferred-plus, etc). In this climate, greater emphasis must therefore be placed on subjective judgment rather than stringent statistical techniques. **As we mentioned earlier, projecting mortality and determining mortality assumptions is clearly an art, as well as a science.** □

for the Council and continue to have difficulty in recruiting speakers to fill our sessions. With more volunteers, the time commitment is minimal and hopefully rewarding. When I meet with many of you, you express interest in getting more involved, however, when the requests for involvement appear, the response is not as great. Perhaps the timing isn't right, perhaps you never received or saw the request or perhaps you just don't think you can find the time. I recognize that you are all extremely busy, but please consider donating your time and expertise. Please consider participating in a session, writing an article for this newsletter, serving on the Council or just sharing your ideas for how we can better server our membership. You can make a difference.

Lastly, I want apologize for the delay in getting this newsletter to you. We originally had the newsletter slated for release in May but due to publishing complications it was delayed. Needless to say, many activities we were planning to discuss had already passed so we needed to pull, re-write and add articles. The Council is committed to bringing the newsletter to you at least three times a year. Special thanks goes to Douglas Doll, our new newsletter editor who will be seeing that we meet this commitment. A big thank you also goes to David Rains (current editor) and Ralph Gorter, who have been co-editors for the past year.

I look forward to seeing you at our breakfast in Boston. Please let me know (or any of the section members) your thoughts on the Section, education and research programs or how we can better serve you. □

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Journal of Actuarial Practice Call For Papers

by Colin M. Ramsay

Papers may be on any subject related to actuarial science or insurance. Papers do not have to contain original ideas. Preference will be given to practical or pedagogical papers that explain some aspect of current actuarial practice. As an international journal, JAP welcomes papers pertaining to actuarial practice outside North America. JAP also accepts technical papers, comments and book reviews. As an international journal, JAP welcomes papers pertaining to actuarial practice outside North America.

Papers may be submitted via e-mail in Microsoft Word, WordPerfect or LaTex format. All papers are subject to a peer referee (review) process. Deadline for submission is **November 30, 2002.**

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Transitioning to the 2001 CSO—

State Adoption and Filing Considerations

by Douglas C. Doll

I expect the NAIC to adopt the model regulation for the 2001 CSO table in late 2002. The question then becomes: how quickly will states adopt the table? In the absence of a push by the insurance industry, there is a chance that there may not be 26 state adoptions in 2003.

Why might the industry not push for speedy adoption? The new table is not completely beneficial for the industry. Maximum allowable premiums will be lower under IRC Section 7702 and 7702A, and cost of insurance charges for universal life and variable universal life may have to be lower. If a state adopts the regulation next year, there is a four-year period until the regulation become mandatory (i.e., until 1/1/2008). If it takes until the following year (2004) to get 26 state adoptions, the three-year transition period will coincide nicely with the transition period for tax reserves (and, possibly, for 7702/7702A). [As an aside, because of the slowness of adopting the regulation, it is possible the industry will ask that the mandatory date be moved back a year (i.e., 1/1/2009)].

We don't have a good precedent for how fast the new table might be adopted. The 1980 CSO was a long time ago, had other significant changes besides mortality, such as valuation interest rates and required legislation. Florida is the only state that will require legislation to adopt the 2001 CSO. The rest of the states require only regulation adoption.

One question is whether codification is a method effectively to get adoption in all states. There is a separate codification task force in the NAIC to add items to the "codification manual." Assuming that the model regulation gets adopted late this year, it is not unreasonable to expect the regulation to be added to codification next year. However, this is not considered sufficient to deem the regulation "adopted" by states. Most, if not all, of the larger states will want to act positively to adopt a regulation of this importance. Most states have not set themselves up to accept changes like this automatically via codification.

A logical question to ask is why the 2001 CSO is different than Regulation XXX, which everyone seems to believe *was* effectively adopted everywhere by codification. First, note that codification doesn't necessarily require that XXX reserves be calculated and held in Exhibit 8. It does require disclosure in the statement of any excess of codification reserves over reserves actually held, however, which many companies regard as an unattractive option. There is an argument that Regulation XXX is differently conceptually than the 2001 CSO regulation. Regulation XXX addressed a valuation issue that was not specifically covered by the Standard Valuation Law. Adopting a new table is different, because the Standard Valuation Law already specifies certain mortality tables.

It is expected that the ACLI, for purposes of measuring the 26 states for prevailing tax table status, will require positive action from each of those states.

There are still states that have not adopted the smoker-distinct or unisex versions of 1980 CSO, but which allow these products to be sold using these tables. However, there is a difference between a different version of table versus a brand new table.

Note that the new table covers nonforfeiture as well as valuation requirements, which is another reason why codification would not be sufficient to consider the table fully adopted.

Another item to consider is that the policy form typically names the mortality table used for nonforfeiture/valuation.

For valuation purposes, I believe this will be the situation during the transition period assuming that you have issued 2001 CSO contracts in some states that have adopted the regulation and 1980 CSO contracts in other states. If your state of domicile has not adopted the new regulation, you have to value all the contacts using 1980 CSO. If your state of domicile has adopted the new regulation, then:

> There is a separate codification task force in the NAIC to add items to the "codification manual."

• For the state of domicile filing, you use 2001 CSO for contracts with 2001 CSO basis, and 1980 CSO for contracts with 1980 CSO basis.

• For filing in a state that has not adopted 2001 CSO, you have to certify that reserves in aggregate meet that state's requirements, which includes valuing all contracts using 1980 CSO. If this requires higher reserves, you may choose to file a separate statement.

The new Actuarial Opinion and Memorandum Regulation which was adopted by the NAIC last year, was originally conceived as a way that an actuary could use state of domicile requirements for actuarial opinions, but the ultimate approach is cumbersome (the ACLI said they opposed the regulation as being nonhelpful), and would permit a commissioner to still require 1980 CSO. It may be slow to be accepted by many states.

Another issue that gets discussed with regards to transition is whether the state insurance departments will be able to handle the extra volume of product filings.

There may be a "crunch" at the beginning of the transition period for, say, term filings (although term filings are generally not that onerous). More likely will be a crunch at the end of the transition period, when a large number of permanent products are expected to be filed.

The ACLI has released a working draft proposal for an optional federal charter for life insurers. In a fact sheet the ACLI put together on "Regulatory Efficiency and Modernization," they contrasted the bank and securities firms who are able to get products to the national marketplace in 30-90 days with life insurers, who they say need six to 18 months. The ACLI is quick to note that a federal charter is just one optional track, and they also are pursuing making state regulation more efficient, which means working with the NAIC.

The NAIC has been trying recently to respond to "speed-to-market" issues. One effort here has been a trial program for the

Coordinated Advertising Rate and Form Review (CARFRA). Ten states participated in this pilot program, which provides a single point of filing and review, along with national standards for insurance products. So far, only one product, a term filing from Prudential last summer, has gone through the pilot. Term is the only individual life product currently in the pilot, but CARFRA is working on standards for UL.

However, slowness in developing product standards, and difficulty at getting all pilot states to agree to them, has dampened enthusiasm for CARFRA. Therefore, the NAIC recently announced a new effort to jumpstart the CARFRA process. They have created a new Interstate Compact Working Group to pursue developing and exposing for comment by June a legislative model for a national system to get products reviewed and approved.

In February, the ACLI submitted a draft to the NAIC of enabling language for commissioners to be able to participate in a natural system of product regulation.

So, it is possible that, by the end of the transition period, filings will be easier and quicker, but you may want to allow extra time for filings "just in case." ☐

The 2001 CSO Impact on Level Term Insurance

by Douglas C. Doll

The most popular term product, guaranteed level premium term (typically, with level premiums for 10, 20 or 30-years) has basic reserves under 1980 CSO that are significantly larger than needed. The 2001 CSO may provide substantial relief from these excess reserves. This article discusses how much impact on profits this relief may provide.

SAMPLE PRODUCT DEFINITION

We designed a sample product for a 10, 20 and 30-year guaranteed premium term product. The risk classes tested were preferred-plus nonsmoker and preferred smoker. (The impact of reserves on standard risk classes would be the same dollar amount, but the gross premiums are larger; therefore, the profit margin impact would be similar, but somewhat lower.) The profit impact was calculated over the level term period. The earned interest rate is assumed to be 7 percent. Lapse rates grade quickly to an ultimate rate of 5 percent. We have assumed that basic reserves are calculated using the ultimate form of the valuation mortality table. (For 2001 CSO, using select & ultimate rates generally would increase reserves by a few percent.)

COST OF RESERVES TO PROFITABILITY

If our profit objective is profit margin discounted at the earned interest rate (7 percent), there is no cost to holding a tax-deductible reserve, because the interest earned on assets backing the reserve offsets the discounting effect of deferred profits. If reserves are not tax deductible, there is an annual cost of holding reserves equal to the tax on interest, or 2.45 percent.

If we are measuring profits based on a higher return on capital measure, the cost of holding reserves is larger. For example, using a 12 percent desired rate of return, the cost of a reserve is 5.00 percent if tax deductible, and 7.45 percent if not tax deductible.

The preceding two paragraphs are applicable for reserves that insurers hold on their statements. However, a substantial amount of term insurance (typically 80-90 percent) is reinsured, with a large part of the reserves ceded offshore to take advantage of lower
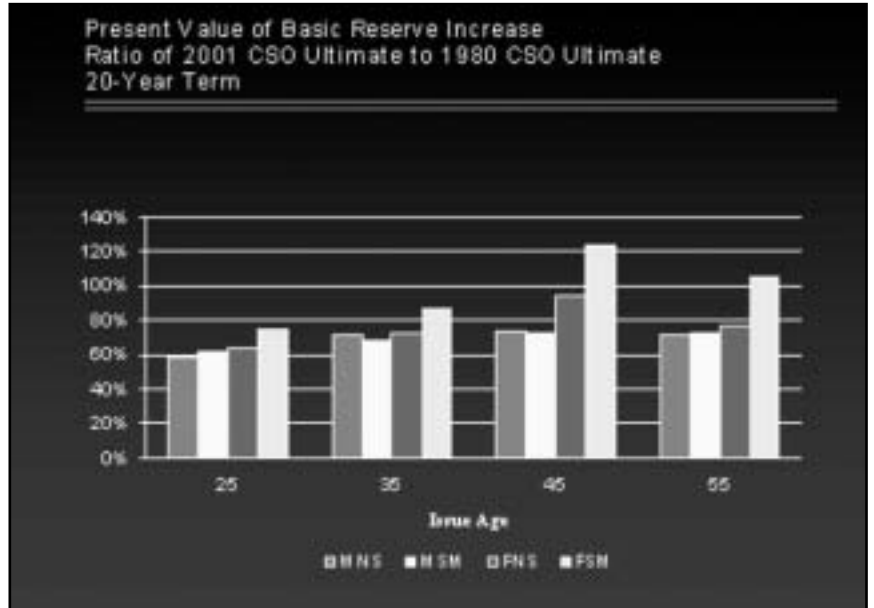
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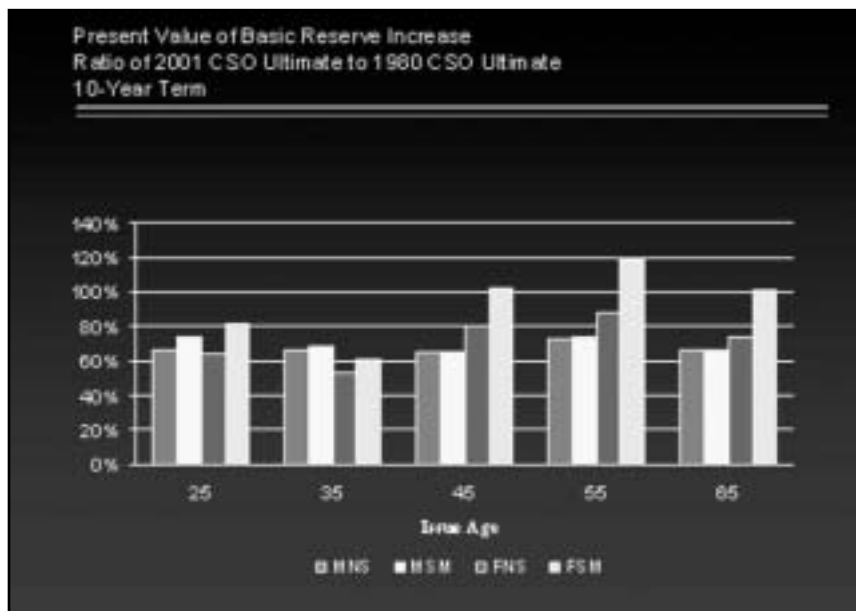
reserve requirements. The excess reserves are backed by a letter of credit or by assets in trust. For purposes of this article, we have assumed that all of the reserve reduction provided by 2001 CSO represents excess reserves that otherwise could have been backed by a letter of credit at an annual cost of 1.00 percent (.65 percent after-tax).
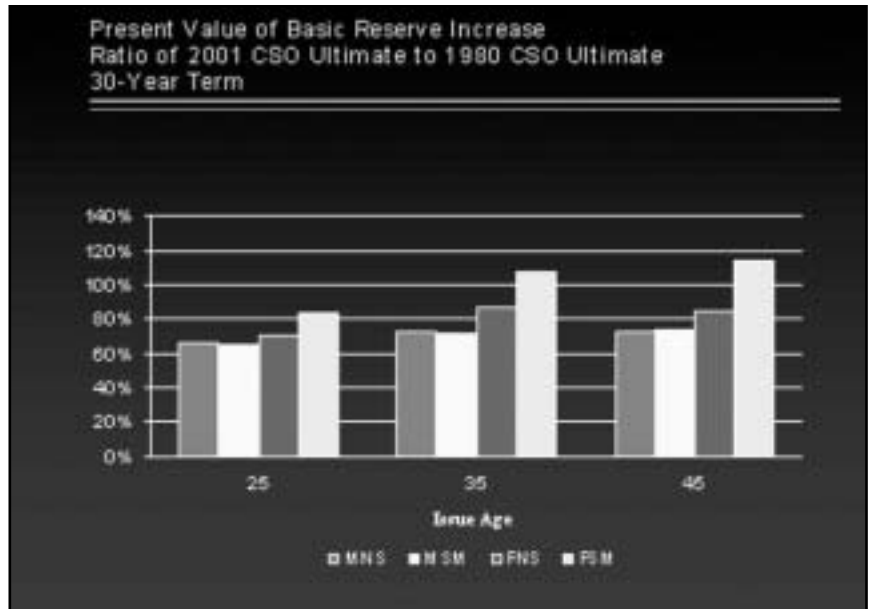
IMPACT OF BASIC RESERVES

Graphs 1A, 1B and 1C compare the profit test present value of reserve increases for the 2001 CSO table as a percentage of the corresponding present value for the 1980 CSO table. These are mean reserves, assuming annual premium mode and discounted at 7 percent. Male reserves are significantly lower using 2001 CSO. Female nonsmoker reserves are lower, but not as much lower as males. Female smoker reserves are actually larger for some issue ages.

With regard to the effects of these reserve differentials on profits, consider the situations for "cost of reserves to profitability" discussed above:

• Reserves held in statement—impact at 7 percent discount. The only impact is due to tax/statutory reserve differentials which are small to begin with. Since the 2001 CSO reserves are smaller for most pricing cells, the tax/statutory differentials are also smaller, which increases the profit margin. However, the magnitude of the impact is negligible for 10-year term, and only .10-.20 percent for the typical 20-year term cell. For
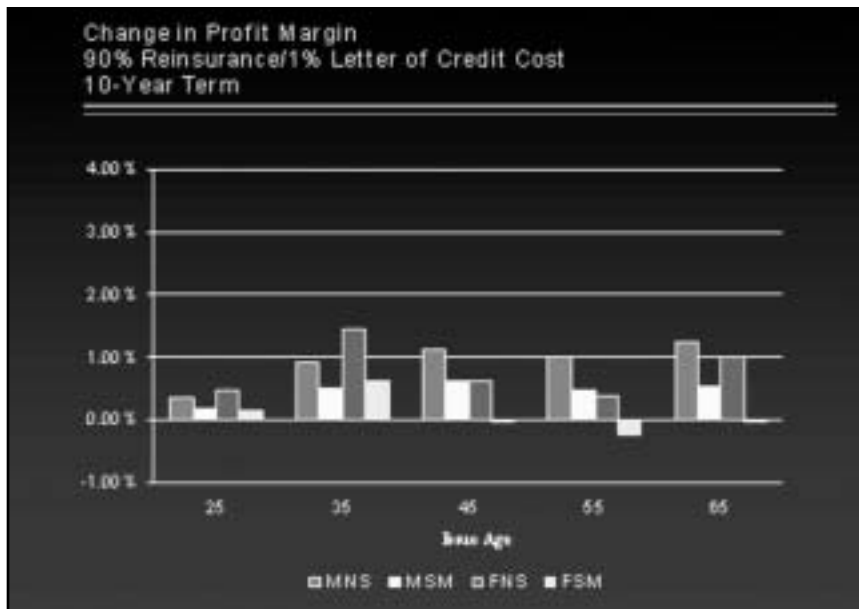

Present Value of Basic Reserve Increase
Ratio of 2001 CSO Ultimate to 1980 CSO Ultimate
20-Year Term

Graph 1C

Present Value of Basic Reserve Increase
Ratio of 2001 CSO Ultimate to 1980 CSO Ultimate
30-Year Term

Graph 2A

30-year term, male profit margins increase .30-.92 percent, and female margins increase less. (Female smokers ages 35 and 45 margins decrease slightly.)

• Reserves held in statement—impact at 12 percent discount. These impacts are fairly large, especially for the longer-term products where reserves are relatively larger. Male nonsmokers have profit margin increases of 2-6 percent for 10-year term, 4-10 percent for 20-year term and 6-14 percent for 30-year term. Results vary by issue age and risk class consistent with the reserve ratios shown in Graphs 1A, 1B and 1C. Female smokers show little or negative improvement.
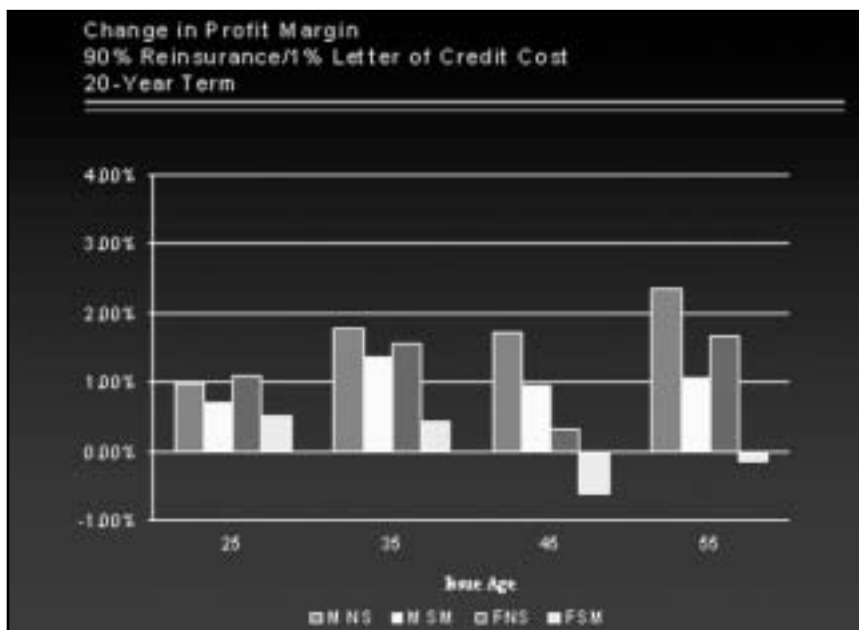
• 90 percent of reserves ceded offshore—impact at 7 percent discount. Since most companies cede a significant portion of their term business, this result is probably more applicable than the first two. The results are shown in Graphs 2A, 2B and 2C. Male nonsmokers have profit margin increases of approximately 1 percent for 10-year term, 1.5-2.0 percent for 20-year term, and 1.5-3.5 percent for 30-year term.

Graph 2B

• 90 percent of reserves ceded offshore—impact at 12 percent discount. At a 12 percent discount rate, the present value of the cost of the letter of credit is smaller, but the cost of the 10 percent retained portion of reserves is larger. The net effect is that the changes in profit margin are similar to, but slightly larger than, the changes using a 7 percent discount rate.

What impact do these profit changes imply for gross premiums? Assuming that insurers desire to maintain the same profit margins, the percentage impact on gross premiums could be approximately twice that for profit margins (because the profit margins are after-tax, and because there is some leverage from percentage of premium expenses).

OTHER IMPACTS OF 2001 CSO TABLE

The 2001 CSO table will affect cash values, but initial calculations indicate that there will not be a large change in the maximum issue age at which level term can be issued without cash values.

The 2001 CSO table will have a significant impact on deficiency reserves for certain issue ages and risk classes. Individual company results will vary based on their slope of pricing mortality and level of gross premiums, but in general, the 2001 CSO deficiency reserves, if any, have the following characteristics, compared with those for the 1980 CSO.

• Nonsmoker deficiencies are lower, particularly where the discontinuity in XXX select factors (attained age 70) is a factor.

• Smoker deficiencies are larger because the 2001 CSO has a steeper slope.

• Deficiencies, if they exist, may last for

Graph 2C

Change in Profit Margin
90% Reinsurance/1% Letter of Credit Cost
20-Year Term
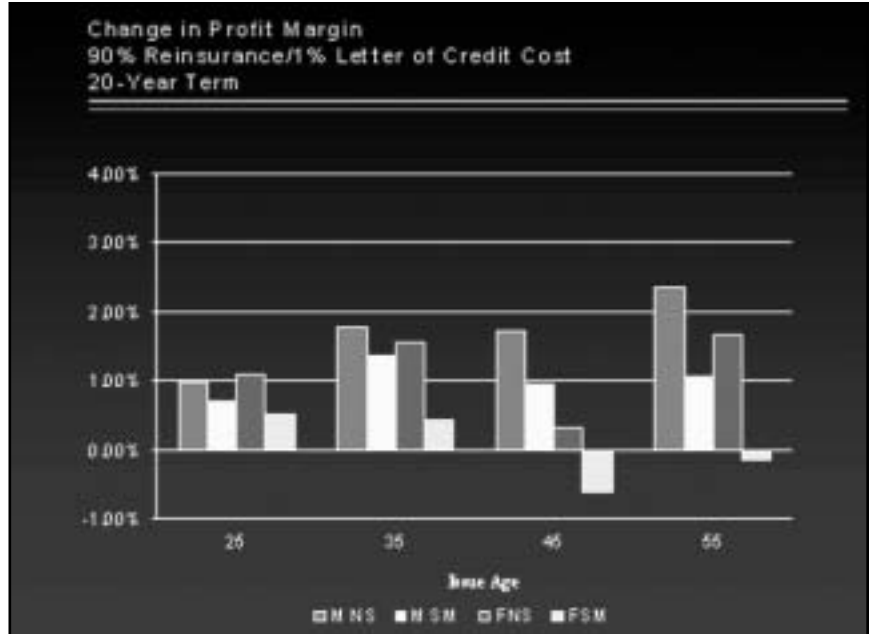
more years because there is less redundancy in basic reserves.

Obviously, having larger or smaller deficiency reserves will also impact profitability, but it is beyond the scope of this article to show sample calculations to illustrate this.

CONCLUSION

There probably will not be much impact on product design due to the 2001 CSO table, but there will be changes in gross premiums. In comparing the impact, male nonsmokers are obvious winners, while female smokers are not. The improvements in profitability are sufficiently large that we expect term writers to switch to the new table as soon as practical. ☐

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Relationship of IRR to ROI on a Level Term Life Insurance Policy

by Wayne E. Stuenkel

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One of the primary pricing measures for individual life insurance products is the internal rate of return on a statutory basis. The internal rate of return (IRR) for a policy is a single interest rate that discounts all policy cash flows back to the issue date of the policy, such that the sum of discounted cash flows equals zero. "Cash flows" include statutory income, taxes, required capital and imputed interest on required capital. An insurer will often require that products be priced to achieve a certain minimum IRR threshold.

Additionally, many companies report annual earnings on a GAAP basis. As a by-product of preparation of GAAP income, an annual return on GAAP investment (ROI) at the line of business level or the product level can be calculated. A GAAP ROI calculation typically includes GAAP income plus imputed interest on required capital in the numerator, and required capital plus stat/GAAP differences (DAC, reserves, taxes) in the denominator.

A recurring question from those who look at product profitability concerns the relationship of lifetime IRR to annual ROI. Some observers (often including insurance company CEOs) expect that the annual ROI for a product should be equal in all years to the lifetime IRR for the product, assuming that product assumptions (lapse, mortality, interest rate, etc.) are met. However, in practice, annual ROI never seems to be equal to lifetime IRR, even if product assumptions are met.

Several excellent papers have been written which examine the relationship between lifetime statutory IRR and annual GAAP ROI. Especially notable in this regard are papers written by Brad Smith (*TSA* 39, pp. 257-293) and Bob Beal (*NAAJ* Volume 4, Number 4, pp. 1-11). However, neither of these papers specifically identified those product variables that cause annual ROI to vary from the lifetime IRR.

So that we could more fully understand the relationship between IRR and ROI, we constructed a term life insurance product. The product provides a level amount of insurance for 20 years, in exchange for equal annual premium payments for 20 years. At the end of 20 years, all policies lapse without value, while the product continues as a whole life product with a high guaranteed premium rate. There are no cash values or dividends. This product is generally consistent with products that are currently being sold; however, it is constructed for the purpose of demonstrating the relationship of IRR and ROI, and does not duplicate the products sold by our company or any other company.

The product was constructed in a spreadsheet for ease of manipulation, and therefore includes several simplifying assumptions (annual premiums and expenses at the start of the policy year, death claims and lapses at the end of the policy year, etc.) The spreadsheet was used to calculate the lifetime statutory IRR and the annual GAAP ROI assuming that all experience emerges exactly as expected.

We found that it is possible to construct a hypothetical product such that expected annual GAAP ROIs are level and equal to the lifetime statutory IRR. The assumptions and methodologies for this product are shown in Appendix A (on page 16).

However, some of the assumptions and methodologies that are necessary to produce expected level annual ROIs equal to lifetime IRR are either actuarially unsound or outside of statutory and GAAP accounting conventions. The assumptions and methodologies that are necessary to produce level annual ROIs equal to lifetime IRR include:
• DAC interest rate equal to IRR rate

• No required capital based on assets, reserves, or insurance inforce net of reserves

• No DAC tax

• Statutory reserves equal to GAAP reserves

• GAAP reserve mortality equal to pricing mortality

• GAAP reserve interest rate equal to pricing earned interest rate

• Lapse rate for GAAP reserves and DAC amortization equal to pricing lapse rate.

In this article, we will refer to the variables above as the "slope-introducing variables," or SIVs.

It was interesting to observe which of the assumptions and methodologies, while changing the *level* of ROI and IRR, did not affect the *relationship* of ROI to IRR. These assumptions included:

• Premium rate per thousand and policy size

• Slope and level of mortality rates

• Lapse rates – both absolute level and pattern (so long as GAAP = pricing)

• Earned interest rate on required capital

• Tax rate

• Reinsurance (if the form is coinsurance)

• Commissions and expenses (both direct and ceded)

• Required capital based on direct premiums.

To examine the effect of the SIVs, we constructed a hypothetical product that had a level ROI that was equal to IRR. (To produce a level ROI that was equal to IRR, the SIVs were set at a level which was either actuarially unsound or outside of accounting conventions.) We then changed each SIV individually to a setting that is typically found in practice, and observed the effect of the change in the SIV on the relationship of ROI to IRR.

The different patterns of ROI that we observed when the SIVs were changed to more typical settings were as follows:

• "Positive sloping ROI", defined as ROIs that are lower than IRR in the early durations, then rise to be greater than IRR in later durations, was observed when (a) the DAC interest rate was set lower than the IRR rate, (b) GAAP reserve mortality was higher than pricing mortality, or (c) GAAP reserve interest rate was less than pricing earned interest rate.

• "Negative sloping ROI", defined as ROIs that are greater than IRR in the early durations, then decline to be less than IRR in later durations, was observed when (a) DAC tax was used or (b) required capital based on reserves, assets, or inforce net of reserves and reinsurance was used.

• The effect of statutory reserves on the slope of ROI depended on the statutory reserving method. Using reserves that are typical of XXX product designs (segmented reserves, no deficiencies) produces a negatively sloping ROI. Using reserves that were typical of pre-XXX product designs (mean reserve of 1/2 cx) produces a positively sloping ROI.

The largest effects on ROI slope arose from the DAC interest rate (positive slope), DAC tax (negative slope), and statutory reserve (both slopes) variables. When we combined all of the assumptions, we found that the product ROI had a generally positive slope for pre-XXX products, and a generally negative slope for XXX products. The slopes of both types of products would become more positive if the loading of GAAP reserve mortality over pricing mortality were increased, or if the reduction in the GAAP reserve interest rate from the pricing earned interest rate were increased. The IRRs and ROIs for the tested variables are displayed in Appendix B. (See both Appendix A and B on page 16). □

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Appendix A
Illustrative Assumptions for Level Term Product

"Slope Introducing Variables" are those *Italicized* Assumptions for which "Typcial" Setting is Different from "Level ROI" Setting

Variable	Setting for "Level ROI=IRR" *	"Typical Setting"
Premium rate	$0.80/M/year	Same
Earned interest rate	7.00%	Same
Tax rate	35.00%	Same
Lapse rate (pricing, GAAP)	12, 11, 10, 9, 8, 7, 6….	Same
DAC tax rate	*0.00%*	*7.70% of net consideration*
Pricing mortallity	45% of 1975-80 S&U	Same
Direct commission + expense	190% (1), 10% (2-10), 4% (11+)	Same
Reinsurance percentage	90%	Same
Resinsurance method	Coinsurance	Same
Reinsurance allowance	100% (1), 50% (2-10), 12% (11+)	Same
GAAP *reserve interest rate*	*Same as earned rate*	*95% of earned rate*
GAAP *reserve mortality*	*Same as pricing mortality*	*105% of pricing mortality*
GAAP reserve method	Net Level	Same
Statutory reserve interest rate	*Same as GAAP rate*	*4.00%*
Statutory reserve mortality	*Same as GAAP mortality*	*100% of 1980 CSO*
Statutory reserve method	*Same as GAAP method*	*CRVM - segmented or unitary (minimum 1/2 cx mean reserve)*
RBC - % of direct premium	3.40%	Same
RBC - *% of net resources*	*0.00%*	*2.76%*
RBC - *% of net inforce*	*0.00%*	*0.14%*
DAC *interest rate*	*Equal to IRR rate*	*7.00%*

* Variables that are not "slope-introducing variables" can be set at any level. Setting at a level different than shown will change the *level* of ROI and IRR, but not the *relationship* between ROI and IRR.

Based on our work, we believe that it is impossible for the annual GAAP ROI for level term life insurance policies to be level and equal to IRR. Even if a company perfectly met all of its pricing assumptions, we believe that certain assumptions and methodologies that are required either by accounting convention or by sound actuarial practice introduce a slope to the pattern of annual GAAP ROIs.

We would be interested to know whether other actuaries have performed similar calculations on other types of business. □

Appendix B
Illustrative Results for Level Term Product

(1) Statutory Lifetime Internal Rate of Return

"Level ROI = IRR" setting	"Typical setting (stat reserves = semented)	"Typical" setting (stat reserves = unitary)
19.10%	11.40%	15.30%

(2) Annual GAAP Return on Investment

Duration	"Level ROI = IRR" setting	"Typical" setting (stat reserves = segmented)	"Typical" setting (stat reserves = unitary)
1	19.1%	13.1%	13.1%
2	19.1%	13.2%	13.2%
3	19.1%	12.1%	13.6%
4	19.1%	11.3%	14.0%
5	19.1%	10.8%	14.7%
6	19.1%	10.5%	16.1%
7	19.1%	10.3%	19.0%
8	19.1%	10.3%	26.4%
9	19.1%	10.3%	75.2%
10	19.1%	10.5%	Undefined
11	19.1%	10.3%	Undefined
12	19.1%	10.3%	Undefined
13	19.1%	10.2%	Undefined
14	19.1%	10.2%	Undefined
15	19.1%	10.3%	Undefined
16	19.1%	10.3%	Undefined
17	19.1%	10.4%	Undefined
18	19.1%	10.6%	60.2%
19	19.1%	10.9%	24.9%
20	19.1%	11.4%	16.2%

* "Undefined" means that the numerator of ROI calculation is positive, but the denominator is negative.

Upcoming Product Development Sessions

at 2002 SOA Annual Meeting in Boston

(for a complete listing of all the sessions, go online at: www.soa.org/conted/bostonprem_annual02.pdf)

Monday, October 28 • 10:30 a.m.–12:00 noon • Session 7 PD

Specialty Track: Product Development

THE MARKETS FOR CRITICAL ILLNESS PRODUCTS [PD]

Moderator: Susan Kimball
Panel: Abraham S. Gootzeit, Tom Ming *

This session explores the aspects and issues of offering a critical illness product in various markets—individual, group, worksite and direct response.

Attendees learn about the different market segments for critical illness products as well as their specific requirements and opportunities. [ME]

Session Coordinator: Susan Kimball

Monday, October 28 • 10:30 a.m.–12:00 noon • Session 8 PD

Specialty Track: Product Development

IMPLICATIONS OF THE NEW CSO MORTALITY TABLE [PD]

Moderator: Nancy M. Kenneally
Panel: Mary Ann Broesch, Barbara R. Gold, Nancy M. Kenneally

The 2001 CSO mortality table is completed and is the proposed replacement of the existing 1980 CSO table. Adoption of the new mortality table has far-reaching implications, including the effect on reserves, cash values, premiums and maximum cost of insurance rates.

Attendees benefit by learning about the new table and how it affects future product development and design.

Session Coordinator: Nancy M. Kenneally

Monday, October 28 • 2:00 p.m.–3:30 p.m. • Session 31 PD

Specialty Track: Product Development

EQUITY PRODUCTS IN DIFFICULT TIMES [PD]

Moderator: Robert K. Leach
Panel: Ellen Eichenbaum Cooper, Noel Henderson Harewood, Robert K. Leach

Many challenges face the issuers of variable products in today's market. Equity markets and variable product revenues have dropped sharply over the last two years. Variable annuity guaranteed living benefits and variable life secondary guarantees have brought new risks to insurers. Reinsurance for derivative benefits is scarce and expensive, and internal hedging is difficult.

Participants gain an understanding of the challenges and sources of risk inherent in managing a variable product portfolio and an appreciation of possible actions that can be taken to achieve growth and profitability in difficult economic environments. [ME}

Session Coordinator: Noel J. Abkemeier

Monday, October 28 • 2:00 p.m.–3:30 p.m. • Session 32 PD

Specialty Track: Product Development

PRODUCT MIGRATION AND WEALTH TRANSFER [PD]

Moderator: Anne M. Katcher
Panel: Kenneth J. Gelman *, David T. Henderson, Anne M. Katcher

What happens when an insured no longer needs current insurance coverage? This session explores customer life cycle needs and current issues with life and annuity products when the customer's needs change. The panelists also discuss the opportunities and risks associated with the migration of customers through products and wealth transfer needs.

Attendees leave with a better understanding of customer life cycle needs, conversions of term insurance to permanent products, converting cash value life insurance and deferred annuities into retirement/distribution products and wealth transfer needs/opportunities. [ME]

Session Coordinator: Anne M. Katcher

Tuesday, October 29 • 8:30 a.m.–10:00 a.m. • Session 57 PD

Specialty Track: Product Development/ Nontraditional Marketing

EXPANDING PRODUCT LINES FOR NONTRADITIONAL DISTRIBUTION [PD]

Moderator: John M. Fenton
Panel: Bret L. Benham *, John M. Fenton, Jeffrey D. Koll

Certain products, such as fixed and variable annuities and supplemental health, have enjoyed success through nontraditional distribution channels, including stockbrokers, financial planners and the worksite. However, to date, these high-velocity nontraditional distributors have not embraced other insurance products, including life insurance and long-term care (LTC).

Attendees learn about potential opportunities in expanding nontraditional distribution. [ME]

Session Coordinator: Nancy M. Kenneally

Tuesday, October 29 • 8:30 a.m.–10:00 a.m. • Session 62 IF

Specialty Track: Product Development

IMPLEMENTING QUICK-ISSUE PROGRAMS: THE PRODUCT DEVELOPMENT PROCESS [PD]

This is part 1 of a three-part seminar. Attendance at all three sessions is recommended.

Panel: Boris Brizeli, Rodney Royce Brown

Distribution expectations, technological advancements, alternative distribution methods, expense challenges and competitive advantages are driving the need to shorten the time between policy application and issue for both fully underwritten and simplified underwritten plans.
The sessions are comprised of presentations by panelists, reviews of case studies and attendee discussion.

Attendees gain an understanding of the types of quick-issue programs available today, what programs might be available in the future and some of the issues for companies to consider before engaging in a quick-issue program. [ME]

Follow up: 76 IF, 96 IF

Session Coordinators: Mary J. Bahna-Nolan, Kevin J. Howard

Tuesday, October 29 • 10:30 a.m.–12:00 noon • Session 73 PD

Specialty Track: Product Development
Noncore Credit: 90 minutes

QUALIFIED PLAN ROLLOVER MARKETPLACE: ARE THE OLD DOGS LEARNING NEW TRICKS? [PD]

A panel of experts discusses what is happening with qualified plan rollovers. The speakers present their understanding of the current marketplace demographics—how much money is rolling over, who is rolling over, and where the money is rolling to. The panel also discusses the products, services and distribution systems deployed to serve this market.

Attendees gain a better understanding of the current rollover market as well as the business models being used to service this market. [ME]

Session Coordinator: Ken A. McCullum

Tuesday, October 29 • 10:30 a.m.–12:00 noon • Session 76 IF

Specialty Track: Product Development

IMPLEMENTING QUICK-ISSUE PROGRAMS: THE PRODUCT DEVELOPMENT PROCESS [PD]

Moderator: Mary J. Bahna-Nolan
Panel: Hank George *, Ernest Testa *

This is part 2 of a three-part seminar. Attendance at all three sessions is recommended. [ME]

Follow up to: 62 IF

Follow up: 96 IF

Session Coordinators: Mary J. Bahna-Nolan/Kevin J. Howard

Tuesday, October 29 • 2:30 pm.–4:00 pm. • Session 93 PD

Specialty Track: Product Development

PRICING AND MANAGING DERIVATIVE RISK: AN INTEGRAL RISK FUNCTION [PD]

Moderator: Paul A. Haley
Panel: Ellen Eichenbaum Cooper, Novian E. Junus, Howard A. Zail

The trend for product features within equity-based products has been to introduce some level of guarantee on the returns of the associated subaccounts. Guarantees of this type, even within an insurance product, must be bifurcated and treated as derivatives for accounting purposes under SFAS 133. This session talks about the methods for pricing these risks and, more importantly, what techniques/products are available to help manage the risk to the insurance company. [ME]

Session Coordinator: Paul A. Haley

Tuesday, October 29 • 2:30 p.m.–4:00 p.m. • Session 96 IF

Specialty Track: Product Development

IMPLEMENTING QUICK-ISSUE PROGRAMS: THE PRODUCT DEVELOPMENT PROCESS

This is part 3 of a three-part seminar. Attendance at all three sessions is recommended.

Moderator: Robert M. Musen
Panel: Michael A. Loffa *, Robert M. Musen, Peter J. Renna

The focus of the third session is technology. Technology is used to facilitate alternative distribution methods such as direct marketing to support existing distribution channels and to speed up the issue process. This session presents current technology platforms and the issues associated with implementing them. [ME]

Follow up to: 62 IF & 76 IF

Session Coordinators: Mary J. Bahna-Nolan, Kevin J. Howard

Wednesday, October 30 • 7:30 a.m.–9:30 a.m. • Session 114 SM/L

Specialty Track: Product Development

PRODUCT DEVELOPMENT SECTION HOT BREAKFAST

Chairperson: Noel J. Abkemeier
Lecturer: Mary Ann Parker *
The Product Development Section celebrates its 20th anniversary. Please join other Product Development Section members for a hot breakfast buffet, a short business meeting and a speaker. This is a great way to meet and socialize with other section members and learn about section activities.

The speaker addresses topics of current interest to section members.

The breakfast is open to Product Development Section members only. There is a non-refundable charge of $15. Please include the additional fee with your registration.

Session Coordinator: Kevin J. Howard

Wednesday, October 30 • 8:00 a.m.–9:30 a.m. • Session 123 PD

Specialty Track: Nontraditional Marketing/Product Development

NONTRADITIONAL APPROACHES TO EFFECTIVELY MARKET SMALLER POLICIES [PD]

Moderator: Maria N. Thomson
Panel: Maria N. Thomson

This panel discussion focuses on how the confluence of cost-effective distribution, rapid new business processing, and products tailored for the middle-income market can lead to profitable sales of smaller policies and expanded mid-market penetration.

Attendees leave the session with a better understanding of how mid-market policyholders can be effectively reached.

Session Coordinator: Tom Bakos

Wednesday, October 30 • 10:00 a.m.–11:30 a.m. Session 141 IF

Specialty Track: Product Development

REGULATORY DEBATE (PART 1): UNIVERSAL VERSUS WHOLE LIFE [PD]

This is part 1 of a two-part seminar. Attendance at both sessions is recommended.

Moderator: Elinor Friedman

Panel: Jeffrey M. Dube, Elinor Friedman, David J. Hippen, David W. Simbro, Michael Scott Smith

The NAIC has introduced many regulations over the past year and is proposing several more that may materially impact life product reserving and cash values. Some may result in narrowing the price gap between universal life and whole life plans. Industry experts and participants discuss and debate the necessity for these regulations, the issues surrounding them and their impact on product design.

The first session in this two-part series focuses on Guidelines XYZ and AXXX and their impact on universal life plans with secondary guarantees versus traditional whole life plans.

Attendees gain an understanding of the upcoming regulatory changes and how they may impact the product and pricing in the future. [ME]

Follow up: 148 IF

Session Coordinator: Mary J. Bahna-Nolan

Wednesday, October 30 • 12:00 noon–1:15 p.m. • Session 148 PD

Specialty Track: Product Development

REGULATORY DEBATE (PART 2): CHANGES TO THE STANDARD NONFORFEITURE LAW [PD]

This is part 2 of a two-part seminar. Attendance at both sessions is recommended.

Moderator: Elinor Friedman
Panel: William John Cummings, David J. Hippen, William J. Schreiner

The NAIC has introduced many regulations over the past year and is proposing several more that may materially impact life product reserving and cash values. Some may result in narrowing the price gap between universal life and whole life plans. Industry experts and participants discuss and debate the necessity for these regulations, the issues surrounding them and their impact on product design.

Attendees gain an understanding of the upcoming regulatory changes and how they may impact the product and pricing in the future. [ME]

Follow up to: 141 IF

Session Coordinator: Mary J. Bahna-Nolan □