SOCIETY OF ACTUARIES

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Is Your Reinsurance Creating Enough Value?

by James W. Dallas

"First-dollar" reinsurance agreements have become commonplace. In fact, figures indicate that approximately 60 percent of new life insurance sales are reinsured, driven by first dollar reinsurance programs. In addition, many of these programs are being implemented on a coinsurance basis for level term business—as opposed to yearly renewable term (YRT) programs.

A direct writer of level term business cedes such business on a coinsurance basis to a reinsurer for two primary reasons.

- Reinsurers are typically on the forefront with mortality trends, and will be more aggressive on their assessment of mortality levels. This aggressiveness then gets passed on in their pricing.

- Direct writers like shifting the burden of the onerous Regulation XXX reserves on to the reinsurers.

Placing less reliance on coinsurance will take some pressures off reinsurers to find the capacity for reserves...

Combining the above two reasons often leads to a leverage of returns for the direct writer. A product with sub-par profitability without reinsurance suddenly becomes a profitable product through the use of coinsurance.

There are recent signs that the use of coinsurance and the inherent shift of the burden of the reserves to the reinsurers are putting stress on the reinsurers' capacity limitations. Reinsurers are able to shoulder only so much of the burden of the reserve strain caused by Regulation XXX. What reinsurers do best, and know best, though, is mortality risk.

If your company is seeing signs from your reinsurers that this is the case, this article will present some thoughts to consider as to why sales of level term products may still be acceptable, even without the support of coinsurance programs. Placing less reliance on coinsurance will take some pressure off reinsurers to find the capacity for reserves, while maintaining the ability of direct writers to leverage off of life reinsurers' ability and willingness to be on the forefront regarding mortality assumption levels.

Value Creation Analysis

Much of the discussion below will make use of embedded value (EV) analysis. EV is an excellent means to better understand how much value is being created for a company. EV is the present value of distributable earnings, where distributable earnings are defined as after-tax book profits, less the cost of holding required surplus. EV has become popular in Europe, as well as in Canada. It is also gaining steam as an accepted and more insightful form of reporting in the U.S., as well (when compared to U.S. GAAP).

The discount rate used to calculate the present value of the stream of distributable earnings varies from company to company in performing an EV calculation. In today's environment, the discount rate typically used to discount the distributable earnings is in the 7 percent to 9 percent range. The rate used to calculate EV is called the Risk Discount Rate (RDR).

For a product priced with a double digit internal rate of return (IRR) on distributable earnings, discounting the same stream of distributable earnings at a 7 percent to 9 percent rate will generate a value greater than zero.

Table 1 on the next page provides a simple example of the development of IRR and EV for a given flow of anticipated distributable earnings for a hypothetical book of life insurance business.

Assuming that EV is the appropriate measure of value, the pricing department should develop products that maximize EV. Maximum EV is not necessarily tied to products with the highest IRR. Maximizing IRR certainly helps, but maximizing IRR does not always maximize EV. For example, one way to maximize IRR is to minimize the investment, but a large IRR on a tiny investment could equate to a small value for EV.

Table 4: Underwriting Acceptance Rate			
	Standard	Substandard	HIV+
Guarantee Issue	100%	100%	100%
Simplified Issue without HIV Testing	100%	50%	100%
Simplified Issue with HIV	100%	50%	0%

Table 5: Insured Mortality					
Year	Standard lx	Substandard lx	HIV+lx	qx Insured	qx I/qxg
0	950*40%*100% =380	45*80%*50% =18	5*80%100% =4	-	-
1	380*(1-0.001) =379.62	18*(1-0.003) =17.95	4 * (1-0.02) 3.92	0.001279	107.90%
2	378.86	17.84	3.76	0.002550	107.76%
3	377.72	17.68	3.54	0.003803	107.50%
4	376.21	17.47	3.25	0.005028	107.11%
5	374.33	17.20	2.93	0.006219	106.62%

Table 6: First Year Mortality Ratios			
	20% Participation	40% Participation	60% Participation
Guarantee Issue	132.96%	114.12%	107.23%
Simplified Issue without HIV Testing	123.91%	107.90%	102.27%
Simplified Issue with HIV Testing	97.31%	92.02%	90.18%

Step 6: Calculate the Insured Mortality Table

Calculating insured mortality involves projecting the number of lives in each risk class and using the total number of lives to construct an insured mortality table, as shown in Table 5.

Expressing the resulting mortality as a percent of the actively-at-work mortality illustrates the combined effect of anti-selection and underwriting selection. A percentage less than 100 percent means that the underwriting selection predominates. A percentage greater than 100 percent means that applicant anti-selection predominates.

Perform What-If Analysis

When pricing worksite products the actuary often has to quantify the answers to "What-if" questions. What if we change the minimum participation requirement? What if we change the level of underwriting? Table 6 illustrates how this process allows the actuary to quantify the impact on mortality of different proposed product designs.

Conclusion

There are many factors that are critical to the success of this process.

- Input from the underwriting department is critical for both estimating the risk distribution of the actively-at-work mortality and the underwriting screen.
- It is critical to recognize that the standard mortality table created in step three is not the table used for pricing the coverage. The table must be adjusted for participation and anti-selection to produce insured mortality.
- Cooperation and understanding between the underwriters and actuaries is critical.
- At the end of the process, the insured mortality must be reasonable. ☐

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Table 2: Actively At Work Standard Mortality Calculation

			Number of Lives			
Year	qx At Work	At Work	Standard (100%)	Substandard (300%)	HIV+ (2000%)	Qx (100%)
0		1,000.00	950	45	5	
1	0.001185	998.82	950 * (1-q1) =949.05	45 * (1-3 * q1) =44.87	5 * (1-20 * q1) =4.90	0.001
2	0.002366	996.45	947.15	44.60	4.70	0.002
3	0.003538	992.93	944.31	44.19	4.42	0.003
4	0.004695	988.27	940.53	43.66	4.07	0.004
5	0.005833	982.83	935.83	43.01	3.66	0.005

Table 3: Participation Rate

	Standard	Substandard	HIV+	Aggregate
20% Participation	20%	70%	70%	22.5%
40% Participation	40%	80%	80%	42.0%
60% Participation	60%	90%	90%	61.5%

apply for insurance. The substandard risks have a higher participation rate as they know that they are receiving value. However, it is unlikely that every member of a risk class, even severely impaired classes, will apply for insurance. There are some individuals that will not elect to purchase insurance regardless of the economic value. The application rate for impaired risks should be bounded between the standard participation rate and 100 percent.

It is important to note that the 20 percent participation scenario will generate an aggregate participation rate greater than 20 percent because the substandard risks elect to purchase insurance more frequently than the basic 20 percent. If an aggregate participation rate of 20 percent is required, you can solve for the standard rates that will yield a 20 percent aggregate participation rate.

Step 5: Estimate the Underwriting Acceptance Rates

The underwriting acceptance rate is the percentage of applicants who are accepted for life insurance. All the standard individuals should be accepted by the underwriting screen. For substandard individuals there are three ways that they can pass through the underwriting screen:

- The underwriting questions do not identify them as substandard
- The individual knowingly commits fraud
- The individual is ignorant of his/her health conditions

The first situation gives the actuary an interesting basis for dialog with the underwriter. The conversation could go something like this:

Actuary: You say we have a 50 percent chance of identifying and rejecting a substandard individual. What can we change to move that percentage to 70 percent?

Underwriter: Adding an additional question about prescription medications will move that percentage to 70 percent.

Actuary: Our producers are asking for a shorter application. What is the impact of eliminating the question about medical treatment in the last five years?

Underwriter: Given the protective value of the other questions, that change will result in identifying and rejecting 30 percent fewer substandard risks.

Table 4 shows a sample underwriting acceptance rate.

The process involves six steps:

1. Estimate actively at work mortality
2. Estimate the actively-at-work risk class distribution
3. Calculate a standard risk mortality table
4. Estimate the participation rate
5. Estimate the underwriting acceptance rates
6. Calculate the insured mortality table

This process has been used successfully to price worksite products. The following example should be considered illustrative and uses assumptions that do not reflect any particular product or pricing situation. It is critical to develop the assumptions in each stage of the process using professional judgment while considering the impact of the target market and product characteristics.

Step 1: Estimate Actively-at-Work Mortality

One of the key mortality advantages of life insurance sold in the worksite is that all the applicants are actively at work. Employees pass through a powerful screen by showing up for work regularly. Major mortality risk factors such as terminal cancer or serious drug abuse are reduced because it is difficult for these individuals to remain full-time employees.

The problem facing the actuary is selecting an appropriate actively-at-work mortality table. The requirements for this mortality table are that it:

- Reflects current experience
- Is sex and smoker distinct and
- Reflects the actively-at-work selection criteria.

Both the actuary and underwriter must evaluate the target market, evaluate the risks of the target industry and adjust the actively-at-work mortality tables accordingly. This method can be applied equally to insurance for miners or insurance for office workers if the actively-at-work mortality table is adjusted correctly.

Step 2: Estimate Distribution for Actively-at-Work Ratings

The actively-at-work population contains both standard and substandard risks. Substandard risks are more likely to purchase insurance than standard risks in the worksite as they face stricter underwriting standards and higher rates if they decide to purchase insurance as an individual. For this reason is it critical to estimate the number of lives in each risk class.

Input from the underwriting department is critical for this step. Underwriters can use information from fully underwritten applications and industry statistics to estimate the distribution of the actively at work risk class distribution. Table 1 shows the assumed distribution for this case study and how the lives are distributed into the risk classes.

Table 1: Actively-At-Work Risk Class Distribution

Risk Class	Numerical Rating	Actively-at -Work Lives
Standard	100%	950
Substandard	300%	45
HIV Positive	2000%	5

Step 3: Calculate the Standard Mortality

The third step is to calculate the mortality for a standard, 100 percent rated, individual. The conservation of deaths principle says that the actively-at-work population can be broken into risk classes and the result must sum to the population mortality, creating a unique mortality rate each year. The net effect is to have one unknown, the standard mortality rate, per year. Subsequent mortality rates can be estimated by a bootstrapping method. Table 2 illustrates the method.

An important point is that the standard mortality rates calculated in this step are not the mortality rates used for pricing the worksite product. The "standard mortality rate" represents the mortality table for a fully medically underwritten product. The following steps adjust the standard mortality rate for both underwriting selection and participant anti-selection to arrive at an insured mortality table that can be used in product pricing.

Step 4: Estimate the Participation Rate

The fourth step is to estimate how many individuals in each risk category will apply for insurance. For this case study Table 3 shows three scenarios: 20 percent, 40 percent, and 60 percent participation rates. Twenty percent participation means that 20 percent of the standard risk class elects to

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Estimating Worksite Mortality—

A Structured Approach

by Adrian R. Pask

For the pricing actuary, estimating worksite mortality is a challenging task. This kind of coverage has characteristics of both individual and group insurance because it is an individual policy that is sold at an employee's place of employment. Additionally, life insurance sold in the workplace is a voluntary benefit, meaning participants elect to purchase the coverage and choose the coverage amount. The voluntary nature of this insurance creates the opportunity for antiselection

because individuals in poor health will elect coverage more often than healthy individuals. On the other hand, insurance company underwriters accept or reject the best risks based upon the information contained in the application. The result is two competing forces driving worksite mortality: antiselection by the applicant population and protective selection by the underwriters.

The problem for the pricing actuary is that the two competing forces are compounded by two elements of the product design process: the number of questions on the application used by the underwriters to select the best risks and the minimum required participation level. Agents want to streamline the sales process by removing as many questions from the application as possible. Removing questions from the application reduces the probability that underwriters can identify a substandard individual. Additionally, the worksite group may have differing levels of participation. Participation is the percentage of the employees at the worksite who apply for insurance. The lower the participation rate, the greater the intensity of anti-selection, because a limited number of substandard individuals will be a larger percentage of the insured population. The pricing actuary is often required to answer questions such as:

- "What is the impact on mortality if we streamline the application by removing a question about prescription medication?"
- "If we lower our required participation from 40 percent to 30 percent, how much will our mortality and resulting premiums increase?"

One solution is to divide the actively at work population into risk classes and view each selection decision as a screen that eliminates individuals in each risk class. For this case study the population is divided into three risk classes: standard risk with 100 percent of standard mortality, substandard risk with 300 percent of standard mortality, and HIV positive risk with 2000 percent of standard mortality. An HIV-positive risk is used in this example because this risk represents a "mortality time bomb" that is identifiable through a question or blood test. The first screen in the process is the employee electing to purchase coverage. It is reasonable to assume that substandard individuals will elect coverage more frequently than standard individuals. This screen will skew the applicant population toward the substandard risks. The second screen is the underwriting process that further reduces the applicant pool. In opposition to the application screen, the underwriting screen selects individuals who are standard and weeds out substandard individuals, skewing the insured population back toward the standard risks.

The mortality of the persisters is assumed to be the difference between total aggregate mortality and the mortality of the excess lapsers. Note that the effect of one year's excess lapse goes away after 15 years, if a 15-year select mortality table is being used. The focus of Dukes/MacDonald's method was on excess lapse due to re-entries to term products, and the method assumed an anti-selection effectiveness of 100 percent.

Becker/Kitsos Method[3]

This method starts with the Dukes/MacDonald method and refines it by adding an effectiveness factor, similar in concept to Shapiro/Snyder effectiveness. In the Becker/Kitsos method, excess lapsers are assumed to have mortality equal to fully select, plus an extra mortality equal to a portion of the initial difference between the select and the persisting group. This extra mortality is graded off over a 15-year period.

The Different Forms of Dukes/MacDonald

The typical formula used today is a modification of Dukes/MacDonald, whereby an effectiveness percentage less than 100 percent is assumed.

The different versions that I have seen used differ based on which group of "persisters" the excess mortality is spread over. The three methods are as follows:

- Method 1: Persisters are those who continue their policy in-force.
- Method 2: Persisters are those who continue in-force, plus the nonselect excess lapsers.
- Method 3: Persisters are those who continue in-force, plus the nonselect excess lapsers, plus the base rate lapsers.

3) "Pricing for Profitability in ART", Best's Review, September 1984, and "Mortality and Lapse Assumptions in Renewable Term Insurance", Reinsurance Reporter, August 1984.

To illustrate the impact of the three methods, consider the following example:

- Base lapse rate is 10 percent
- Total lapse rate is 85 percent
- Effectiveness is 80 percent
- Select and point-in-scale mortality rates are .01 and .03, respectively

Assuming 100 lives, I now calculate the mortality ratios for the in-force business for the three methods:

- Base lapses = 10
- Excess lapses = 85 – 10 = 75
- Select excess lapses = .80 * 75 = 60
- Nonselect excess lapses = 75 – 60 = 15
- Extra mortality on persisters = 60* (.03 - .01) = 1.20
- Method 1 mortality ratio = (.03 + 1.20 /15) /.03 = 367%
- Method 2 mortality ratio = (.03 +1.20 /30) /.03 = 233%
- Method 3 mortality ratio = (.03 + 1.20 /40) .03 = 200%.

The differences among the three methods are significant and demonstrate that it is important that you know exactly how mortality deterioration is calculated in your pricing models. □

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Mortality Anti-selection —

Different Versions of Dukes/MacDonald

by Douglas C. Doll

A common method for projecting the mortality associated with high lapse rates is to use the so-called Dukes/MacDonald approach. I have found more than one version of Dukes/MacDonald being used in practice. It is important that we are aware of which version is being used, so we understand how much extra mortality we are projecting. The purpose of this article is to provide some background on anti-selection formulae (for those who,

unlike me, are not old enough to have been around when they were developed), and to describe the different forms of "Dukes/MacDonald" that I have seen.

Anti-selection Formulas

This topic came to the forefront during the "term wars" of the early 1980s, when ever-decreasing term rates caused very high lapse rates on existing term products. The development of select and ultimate rate scales for term insurance was expected to lock in high lapse rates, as healthy lives had significant incentive to lapse and start over on a new select scale. Finally, term products with explicit re-entry provisions required the actuary to estimate the mortality of the non re-entered group as well as the re-entries.

Three major methods to calculate the mortality of the persisters were published in the 1980s. They are similar in their underlying theory, but somewhat different in mechanics and results.

Shapiro/Snyder Method[1]

The mortality of the persisters is expressed as ratios to standard mortality. Each duration a new ratio is calculated equal to the prior year's ratio, plus an increment to the ratio calculated assuming that the extra lapsers are fully select. Refinements to the model include an assumption that lapsers are not fully select (by introducing an "effectiveness" percentage), and by grading off over time the increments to the mortality ratio.

Dukes/MacDonald Method[2]

This method uses the concept of conservation of total deaths. The excess lapsers are assumed to be fully select at the time of lapse, but their mortality grades to ultimate in normal fashion.

1) "Mortality Expectations Under Renewable Term Insurance Products", Proceedings of the Conference of Actuaries in Public Practice, Vol. XXX.

2) "Pricing a Select and Ultimate Annual Renewable Term Product", Transactions of the Society of Actuaries, Vol. XXXII.

Product Design Flexibility

Periodically over the last 17 years there has been a push to make broad revisions to nonforfeiture requirements, and one of the quinquennial efforts is now occurring. Whether change occurs now or five years from now, change is inevitable. The Standard Nonforfeiture Laws for Life Insurance (1942) and Deferred Annuities (1976) both have their roots in eras that predated today's computer capabilities, liberalized financial regulation structures, available financial products, and constantly evolving consumer needs and preferences. The formulaic requirements of the current laws will be replaced with more flexible approaches that will allow new product designs.

A single product may be capable of accommodating multiple risks equally, e.g., life, health, annuity, long-term disability, homeowners, auto, etc., rather than accommodate them only as small ancillary benefits on a primary product. Life cycle products that start as life insurance and evolve into an annuity and then long-term care may be available. Products may have personally designed balances among death benefit, premium and cash value, including no cash value despite sizable premiums.

Increased Disclosure

Historically, sales disclosure has been pushed by regulators for the purpose of consumer protection. The ever-growing culture of litigiousness and the widening circle of class action law suits has intersected with increasing product complexity and will cause insurers to take a leading, if not controlling, interest in providing full disclosure. The product complexity will be characterized by personalized product design and/or personally adaptable sales illustrations that demand disclosure.

Genetic Testing

Genetic testing will have moved from the laboratory to being used by individuals. A common-sense business approach toward underwriting will evolve despite some legislative pressures to the contrary, and it will allow genetic test results to be treated like other components of medical history, namely something that must be disclosed on an application and is available for forming an underwriting decision.

Immediate Annuity Creativity

Limited attention has been paid by insurers to immediate annuities because the insurance industry never achieved enough sales to form a critical mass. The aging of the baby boomers, the increasing awareness that managing one's own investments is not as easy as it once looked, and emerging education about the risk of unpredictably living too long will lead to the long-awaited emergence of the immediate annuity market. This will lead to much broader and more competitive offerings of underwritten annuities, including those that are attractive to purchasers with impaired health. The degree of creativity that has marked the deferred variable annuity market for the last 10 years will expand into immediate annuity products; however, insurers will be more cautious about the new types of product design risks they take on.

Will these changes all occur? Let's check back in seven years (when I have purchased an attractive and fully disclosed immediate annuity that contains multiple benefits, none of which imposes great risk on the insurer).

* * * * *

Before we get to 2010, there are enough current risks that insurers face. The Product Development Section has initiated a research project called the Analysis of Product Guarantees that will analyze the various guarantees provided in fixed and variable life insurance and annuity products. The study is intended to identify the guarantees and their associated risks, describe pricing methods and measures and quantify the impacts on policyholder behavior. The results should be a valuable resource for product development actuaries. We will keep you apprised of the progress of the study. ☐

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Comments from the Chair

The Shape of Products in 2010

by Noel J. Abkemeier

What might the product world look like in 2010? A number of forces are developing that will heavily influence the products that characterize the life insurance and annuity market in the mid-term future. Some are already taking effect, while others will evolve over several years.

Risk Management

Asset-liability management was in the spotlight in the early 1980s when interest rates spiked. It returned to the spotlight in recent years because of the risk concentration created by many insurers' heavy reliance on variable annuities and the sale of derivative-based benefits added a new dimension of concentrated risk. The impending arrival of C3-Phase II risk-based capital requirements for variable products, the scrutiny of rating agencies and the scarcity of reinsurance already are causing a retreat in equity put-based benefits and will probably lead to more severe reductions.

The availability of guaranteed living benefits and guaranteed minimum death benefits will be limited by an insurer's ability to hedge them through internal product balancing and diversification. Dynamic hedging and reinsurance will remain in the background. The result will be significantly less prominence for these currently popular guaranteed benefits.

Equity-indexed benefits, which gained popularity as a product designed for the conservative equity investor, will gain new popularity as a product for the prudent insurer to deliver guarantees. Their ability to be hedged with call options will be valued.

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