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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.

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.

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