Long-term care first principles modeling: Mortality assumptions

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This article continues Milliman's series on long-term care (LTC) first principles modeling. The first article in the series,[1] released in March 2016, introduced the topic and set the stage for the series of case study discussions that would follow. This article continues the discussion by examining the development of mortality assumptions for use in an LTC first principles model. Our introductory article noted that the development of separate mortality assumptions for healthy and disabled lives creates unique challenges for companies using first principles modeling. In this article, we examine those challenges in more detail and discuss how we have worked with companies to overcome them. At the same time, we comment on the advantages and opportunities that go along with an enhanced approach to modeling mortality in a first principles context.

Choosing an approach

Legacy models for LTC business have often used total life mortality assumptions, in which status (healthy versus disabled) is not necessarily tracked and the same mortality assumption applies to all lives, regardless of status. By contrast, many first principles models track policyholder status. In some first principles models, policyholders are classified as either "healthy" or "disabled." Others allow for more sophisticated tracking of status, such as healthy, disabled, or healthy following claim recovery, and may even track transitions between care situs. Models that track policyholder status allow for a more refined approach to modeling mortality, in which separate mortality assumptions are applied to healthy lives and disabled lives. With this comes potentially improved accuracy of claim status and claim exposure. It also allows for more accurate benchmarking of results—i.e., it allows for the ability to track if actual open claims are developing as expected. However, it also presents additional challenges of selecting credible assumptions at this more granular level.

Before developing more refined mortality assumptions, we have found that it is important to spend time considering the overall approach that will be used. In general, one can express mortality assumptions on three different bases—a healthy life basis, a disabled life basis, and a total life basis. For a first principles model, assumptions are needed on two different bases (e.g., active life and disabled life), which then imply or define the third basis (e.g., total life).

There are three approaches that are commonly used for developing first principles mortality assumptions. The approaches differ with respect to which two bases are used to develop assumptions and which basis will be implied. The three general approaches can be described as follows:

1. Develop healthy life and disabled life mortality assumptions independently. The total life mortality assumption is then implied.
2. Develop a healthy life mortality assumption and back into an implied disabled life mortality assumption by preserving deaths consistent with a total life mortality table.
3. Develop a disabled life mortality assumption and back into an implied healthy life mortality assumption by preserving deaths consistent with a total life mortality table.

In all three cases, experience studies are warranted. The approach selected determines how those experience studies will be conducted, what data will be necessary, and the challenges that will exist. An issue common to all three approaches is that data credibility may be limited, particularly for advanced attained ages and late policy durations. This problem can often be overcome by supplementing company-specific data with external data, such as that available from industry studies or from consulting firms.

Not surprisingly, each approach has its advantages and disadvantages. Conceptually, approach #1 is perhaps most consistent with the objectives of a first principles model. This approach builds the mortality assumption from the ground up, separately taking explicit consideration of the mortality experience of healthy lives and disabled lives. Companies, however, may have limited historical data to conduct experience analyses on this basis. If credibility is limited, one should carefully consider if the separate assumptions for healthy lives and disabled lives mortality bear a reasonable relationship to legacy assumptions or to mortality assumptions developed on a total lives basis. If the healthy life and disabled life mortality assumptions do not combine to produce something reasonably consistent with the mortality the company has experienced on a total life basis, this may be reason to further investigate the development of the assumptions or explore the remaining approaches.

1 See http://us.milliman.com/insight/2016/Case-study-Long-term-care-insurance-first-principles-modeling/

Approaches #2 and #3 are variations on a theme that involves preservation of total life mortality. The primary advantage of these approaches is that they will, by design and construction, necessarily produce results that bear a reasonable relationship to a desired total life assumption (perhaps one that has been used in the company's legacy LTC model). The primary disadvantage is that the "back-in" assumption may produce unexpected or unreasonable patterns—for example, implied mortality rates that are not smooth or do not increase by age.

While preservation of total life mortality is a reasonable goal in itself, it is important to ensure that implied mortality rates will not distort future results. If, for example, one is using implied disabled life mortality rates and those rates show unusual patterns at advanced ages, this could skew the calculation of future claim reserves and the projected runout of paid claims.

A consequence of creating an implied mortality table (as in approaches #2 and #3) is that the table will vary by many characteristics. Each assumption that impacts the transition of a policyholder from healthy to disabled status—e.g., incidence, continuance, utilization, benefit exhaust, lapse—will impact the implied table. As a result, the implied mortality table will vary by all of these characteristics. To limit the complexity and improve the efficiency of a model, it is often desirable to create a more compact assumption table by aggregating assumptions across some of the less crucial characteristics. In doing so, care may be necessary to ensure that important mortality drivers are still captured in the final assumption. Some companies, however, prefer simplicity over sophistication in this respect. Companies may be willing to accept a slightly less granular assumption to achieve a less complex, more computationally efficient model. In those cases, a cost-benefit analysis may be helpful to determine the point at which the improvements in the model do not warrant the additional complexity or model run time.

A subtle, but important, challenge associated with approaches #2 and #3 is that preservation of total life mortality may not appropriately capture changes in mix of business over time. A total life mortality table implicitly reflects a defined mix of healthy versus disabled lives—for example, the 1994 Group Annuity Mortality (GAM) table reflects that a certain percentage of policyholders with attained age 85 are disabled. To the extent that an insurer's mix of business falls out of line with the mix implied in the total life table, the model could produce unintended results. If, for example, the insurer's block of business has 30% of policyholders with attained age 85 being disabled, while the total life mortality table reflects a population with only 20% of 85-year-olds being disabled, preserving the total life mortality would potentially understate projected mortality. The total life mortality assumption in this example implicitly reflects a lower proportion of the population being disabled than is true in the insurer's mix of business, which introduces a downward bias into the mortality rates.

The overarching consideration is that, regardless of approach, careful review of the assumptions is indicated to ensure both that reasonable patterns in the assumptions exist and that consistency with other assumptions is achieved, where appropriate. The level and type of review depend heavily upon the approach selected.

Developing an active life mortality assumption

Given the challenge of developing mortality assumptions for two out of the three bases (healthy life, disabled life, and total life), many companies choose to develop assumptions for active life mortality. The reasons for this are understandable. Companies generally have a much larger volume of historical data on active life mortality than on disabled life mortality. This is particularly true for less mature LTC blocks. Additionally, many commonly used industry mortality tables could be adjusted to an active life basis, although doing so may require external sources of data to supplement company experience where it is not fully credible. Milliman will soon complete an LTC mortality study that may be helpful in this regard. Companies could base their assumptions on internally developed experience studies and use outside sources where they believe them to be necessary.

Active life mortality has unique challenges and requires special consideration. The well-known problem of accurately classifying a policy termination as a lapse or a death is magnified on an active life basis. Because only active life policyholders will lapse, the importance of the lapse component becomes proportionally larger on an active life basis relative to a total life basis. With disabled lives, it is generally more transparent whether a termination is due to claim recovery or death. The classification problem can, to an extent, be overcome by consulting the Social Security Administration "Death Master" file. This approach has worked well historically, but the Death Master file is known to have underreported deaths beginning in or around 2011. Additionally, there may be other sources of mortality data, such as firms that search obituaries for death records.

Even when companies have fully credible active life mortality data in the aggregate, that data is generally sparse at advanced attained ages and late policy durations. This problem is generally not solvable by looking to publicly available data such as the Death Master file. The problem is caused by lack of exposure at advanced ages and late policy durations, not misreporting of experience. However, the problem may be resolved through use of external data, as discussed earlier.

In working with clients, we have uncovered insights into the slope of the mortality curve at advanced attained ages and unexpected relationships of LTC-insured mortality experience

to industry mortality experience as presented in annuity mortality tables. Our work has also allowed for insight into the durational pattern of mortality underwriting selection on LTC blocks. Appropriate mortality selection factors materially improve the actual-to-expected fit of the active life mortality assumption. This has the additional benefit of materially improving assumed voluntary lapse rates when those rates are developed from total policy termination rates less an assumed active life mortality.

Developing an active life mortality assumption also raises interesting questions and challenges concerning the relationship of active life mortality rates to total life mortality rates (as, for example, in the 1994 GAM or Annuity 2000 mortality tables). One generally expects that active life mortality should be lower than total life mortality, but it is not always apparent what constitutes a reasonable and expected ratio of active life mortality rates to the total life mortality. As noted earlier, this challenge is magnified in the tail of the mortality curve.

Developing a disabled life mortality assumption

Companies pursuing approach #1 or #3 face the challenge of developing a standalone disabled life mortality assumption. Disabled life mortality experience data is generally less credible than active life mortality data. Additionally, it may be challenging to correctly categorize a death as a "disabled life" death—for example, if death occurs during the elimination period and before the claim is reported to the insurer. In that case, the mortality exposure is most consistent with a disabled life death, but the insurer may not have the information required to treat it as such. Although this creates unique challenges, they can be overcome. Supplementing a company's disabled life mortality experience with industry data is an option for many companies. Other companies may develop implied disabled life mortality rates by backing out recoveries from claim termination rates.

Companies have encountered mixed success developing implied disabled life mortality rates from claim termination rates. On the one hand, claim terminations and recoveries may be sufficiently credible when the business is split certain ways—that is, the data is a credible basis upon which to develop claim continuance curves. One might expect that the implied disabled life mortality rates should therefore warrant some level of credibility, even if observed deaths do not, by themselves, meet the standard for full credibility. On the other hand, developing implied disabled life mortality rates in this fashion can yield unexpected results, including mortality rates that are not smooth by age and claim duration, or rates that do not increase uniformly by age.

Trends in disabled life mortality rates by claim duration also complicate the analysis. One might generally expect that disabled life mortality rates show a concave pattern, with elevated mortality rates in early claim durations, which wear off quickly before increasing uniformly in a more typical attained-age pattern. Indeed, we see this pattern in our studies of disabled life mortality. The challenge lies in discerning how elevated the mortality rates are in early claim durations and the rate at which the elevated mortality wears off. In some cases, deciphering the appropriate durational trend can solve the problem of disabled life mortality rates that appear to exhibit unsmooth or non-increasing patterns by attained age—i.e., smoothness and uniformly increasing rates can be achieved when durational impacts are appropriately considered.

In some cases, development of a reasonable disabled life mortality assumption using company-specific data is possible once certain trends and adjustments are incorporated into the analysis. In other cases, it may be desirable to supplement company-specific data with trends seen in industry data.

Mortality improvement

Mortality improvement adds an interesting dimension to the development of complete mortality assumptions. It is generally difficult to identify mortality improvement trends in company-specific data. It is even more so if one is concerned specifically with disabled life mortality improvement.

Milliman has conducted research documenting mortality improvement for LTC blocks on a total life basis. The research reveals mortality improvement that is generally in line with the mortality improvement scales associated with industry tables—e.g., Scale G2 associated with the 2012 Individual Annuity Mortality table.

The application of mortality improvement in a first principles model requires very careful consideration. While it may be possible to apply a total life mortality improvement assumption to both healthy lives and disabled lives, a more accurate approach would apply separate improvement assumptions to healthy versus disabled lives. Some expect that most or all of the mortality improvement observed on a total life basis is driven by improvement in healthy life mortality, with little or no disabled life mortality improvement. If so, then applying total life mortality improvement to disabled lives could unintentionally lengthen the projected paid claim runout, with the potential for an unintended overstatement in projected claim payments. Others expect that disabled life mortality is improving, even if at a lesser rate than active life mortality. In any case, a material advantage of first principles models over many legacy models is that first principles models allow for explicit modeling of disabled life mortality improvement. In many legacy models, modeling disabled life mortality improvement could only be accomplished through use of a complex set of continuance curves, which vary by projection year to allow for increasing length of stay over time.

Careful consideration is warranted before applying mortality improvement on a healthy life basis. Applying mortality improvement assumptions developed on a total life basis to healthy lives can produce unintended results. Analysis conducted by Milliman demonstrates that total life mortality improvement assumptions that continue for a fixed number of years—e.g., 1% improvement for 10 years—imply the following for a healthy life basis if financially equivalent projections are to be achieved:

- The mortality improvement percentage on a healthy life basis should be higher
- The mortality improvement extends indefinitely on a healthy life basis (even though only for a fixed number of years on a total life basis)

Both of these observations result from a shrinking exposure basis to which the assumption is applied on a healthy life basis—i.e., as the proportion of healthy lives relative to total lives diminishes over time, the improvement that is applied to that diminishing population needs to increase to keep pace with the assumption when it is applied to all lives.

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