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Key insights from LTC first principles modeling

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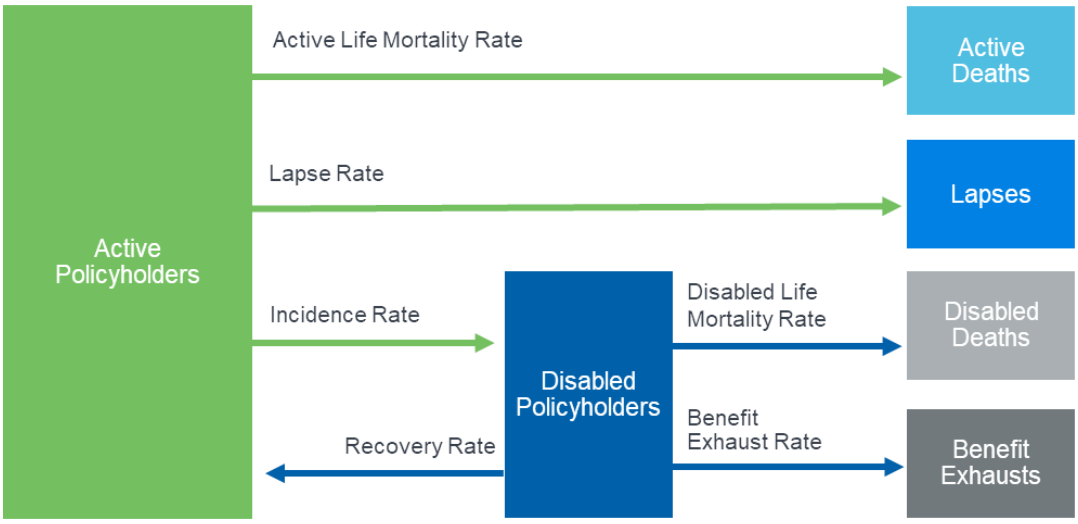
In the past five years, many long-term care (LTC) insurance carriers have moved from a claim cost model approach to a first principles model approach to create business projections and perform cash flow testing.

In the context of this article, a first principles approach allows a company to study policyholder behavior in more detail and understand policy migration over time. A first principles model breaks down assumptions for policy behavior (e.g., incidence rates, claim termination rates, and utilization) to their components and models them.

In contrast, a claim cost model composites these three assumptions before entering them into the model. Although actuaries still develop assumptions in aggregate (not at the policy level), this approach allows companies to understand individual policy performance better. For example, a first principles model allows the user to analyze claim incidence, disabled life mortality, and claim recoveries on a seriatim level, based on each policyholder's specific policy characteristics. This article discusses modeling and the information that companies can glean from a first principles approach.

Once a policyholder purchases a policy, that person is part of the in-force business and considered an active policyholder. Policyholders can move from this active state when they commence a claim (become disabled), lapse the policy, or die (active life mortality). A disabled life can return to the active state with a recovery. Depending on how long the business has been in force, policies will already be in the disabled state. A disabled life can leave the in-force business when the benefits are exhausted or the policyholder dies (disabled life mortality). The diagram in Figure 1 illustrates the policy movements and the assumed rates associated with these movements. Some first principles models allow you to consider transfers between situs within the disabled bucket, but this is not included in Figure 1. The remainder of this article will discuss the transitions shown.

FIGURE 1: MIGRATION OF A POLICYHOLDER IN A FIRST PRINCIPLES MODEL



Active Life Policy Terminations = Active Deaths + Lapses
Claim Terminations = Disabled Deaths + Recoveries
Total Policy Terminations = Active Deaths + Lapses + Disabled Deaths + Benefit Exhausts

TRANSITIONS FROM ACTIVE POLICY STATUS

Incidence rates typically vary by gender, underwriting, issue age and policy duration, attained age, benefit trigger (e.g., two of six activities of daily living [ADLs] or medical necessity), elimination period, and other variables. Figure 2 shows a sample attained-age curve that we might expect.

FIGURE 2: ILLUSTRATIVE INCIDENCE CURVE

ATTAINED AGE	ANNUAL INCIDENCE RATE*
65	0. 5%
70	1.0%
75	2.0%
80	4.2%
85	8.0%
90	13.8%
95	16.5%
100	19.0%

* This example is meant to be illustrative. Actual incidence rates will vary significantly.

Voluntary lapse rates and active life mortality rates in total make up active life policy termination rates. If the company has an accurate way to track policy deaths, the actuary can study these two items separately. However, in some cases, companies do not collect accurate death information and are thus unable to accurately split the policy termination into active deaths or lapse. It is therefore best to develop the active life mortality and lapse rate assumptions by studying total active life policy terminations. In this instance, a separate assumption is developed for lapse and active life mortality, but model and assumption validation should be focused on the total active life policy termination basis. The industry does not have a standard active life mortality table or a standard total life mortality table. An actuary can also develop the total life mortality and disabled life mortality assumption separately and use them to determine the implied active life mortality rate. However, if the disabled life mortality rates and total life mortality rates do not vary by the same factors it can lead to unintuitive active life mortality rates for some policies. On the contrary, if the actuary develops disabled life mortality and active life mortality separately, then the assumption could be lower or higher than what the historical total life mortality rate experience has been.

The table in Figure 3 shows how these assumptions might interact. As attained age increases, the total life mortality rate is comprised of a higher proportion of disabled deaths.

TRANSITIONS FROM DISABLED POLICY STATUS

Once a policy becomes disabled, the model will calculate future paid claims and a corresponding present value of amounts not yet due. An actuary should use similar assumptions for both the claim reserves and the projections (there may be some differences, e.g., interest rates). These assumptions will include a claim termination assumption (shown in Figure 1 above as disabled life mortality rate and recovery rates) and a utilization assumption (how many of the dollars per day and days per week or month the policy uses of the maximum allowed amount). The assumptions will typically vary based on the policy's claim adjudication method (e.g., pool of money, service day reimbursement, indemnity). Many of today's LTC policies are comprehensive, meaning the policy will cover nursing home, assisted living, and home healthcare claims. Often a policyholder on claim may transfer from one site of care to another during the length of the claim. It may be time- and resource-intensive for the model to track the claim moving from various states while on claim. In order to address the time and resource constraints, a first situs model may be used where each claim is categorized based on the situs where the claim begins. In a first situs model, the transfer rate is embedded in the utilization assumption (percentage of maximum daily or monthly benefit used each day or month) and claim termination assumption. If the actuary chooses to model a current site of care instead, transfers between sites of care would need to be modeled explicitly and would not be embedded in the utilization and claim termination assumptions.

FIGURE 3: ILLUSTRATIVE ACTIVE, DISABLED, AND TOTAL LIVES MORTALITY RELATIONSHIP BY ATTAINED AGE

Attained Age	Total Life Mortality Rate	Active Life Mortality Rate*	Disabled Life Mortality Rate*	% Deaths That Are Disabled	% of Block on Claim by Age	Active Life Mortality Rate (active life basis)	Disabled Life Mortality Rate (disabled life basis)
67	1.0%	0.8%	0.2%	20.0%	2%	0.8%	10.0%
72	1.5%	1.1%	0.4%	25.0%	2%	1.1%	18.3%
77	3.1%	2.0%	1.1%	35.0%	5%	2.1%	21.5%
82	5.5%	3.0%	2.5%	45.0%	10%	3.3%	24.5%
87	10.0%	5.0%	5.0%	50.0%	18%	6.1%	27.8%
92	16.7%	7.5%	9.2%	55.0%	30%	10.7%	30.6%
97	31.3%	12.5%	18.8%	60.0%	45%	22.7%	41.7%

* Stated as a percentage of total lives for the purpose of this illustration.

The utilization assumption typically varies by coverage type (stand-alone or comprehensive), adjudication method, site of care, inflation protection option, and home healthcare percentage. We might also expect utilization to vary by region, current daily benefit amount, and benefit period. Utilization assumptions also typically vary by either policy or claim duration, due to changes in actual charges relative to the benefit maximum over time. Figure 4 illustrates some utilization assumptions, which show how utilization rates will vary due to embedded transfer rates (modeling on a first situs basis). The utilization assumption estimates how much of the total maximum benefits the policyholder actually uses. This may be due to using less in days or dollars than the maximum available, depending on the policy language. Stand-alone nursing home (NH) might show 100% for indemnity and stand-alone home healthcare (HHC) might show 65% due to using only five out of seven days and less in dollars than the daily maximum. However, when a policy starts in HHC and moves to NH, then the experience would include the amounts of days and dollars that the policyholder used of HHC and NH, respectively, and the embedded transfer rate. Therefore, in this example, a comprehensive policy with first situs HHC, we would expect to have a result between 65% and 100%, grading closer to 100% over time.

FIGURE 4: ILLUSTRATIVE UTILIZATION AMOUNTS

HHC Percentage*	First Situs	NH Benefit Type	HHC Benefit Type	Utilization Assumption
Stand-alone				
N/A	NH	Indemnity	N/A	100%
N/A	NH	Reimbursement	N/A	92%
N/A	HHC	N/A	Reimbursement	65%
Comprehensive				
50	NH	Indemnity	Reimbursement	94%
		Reimbursement	Reimbursement	90%
	HHC	Indemnity	Reimbursement	78%
		Reimbursement	Reimbursement	72%
100	NH	Indemnity	Reimbursement	93%
		Reimbursement	Reimbursement	87%
	HHC	Indemnity	Reimbursement	70%
		Reimbursement	Reimbursement	67%

* HHC Percentage is the amount of the HHC daily benefit as a percentage of the NH daily benefit amount.

Claim termination assumptions will typically vary by claimant age at the onset of disability, claim duration, gender, benefit period, site of care, and other policy features. If diagnosis data is accurately reported and credible, the claim termination assumptions can also vary by diagnosis. However, varying by diagnosis adds to the modeling complexity. For claim reserve purposes, the claim termination rate in aggregate, not split by recoveries and disabled deaths, is needed to determine when the disabled life reserve is released. However, this assumption needs to be split for the first principles model to determine what happens to the policy once it goes off claim. If the claimant dies, the policyholder will leave the model. However, a policyholder who recovers (who still has benefits left to use) will go back into the active population. Figure 5 shows an illustrative percentage of terminations due to death. The percentage of terminations that are recoveries are the complement of the disabled death ratios in Figure 5.

FIGURE 5: ILLUSTRATIVE DISABLED DEATH RATIOS AS A PERCENTAGE OF TOTAL CLAIM TERMINATIONS ON A FIRST SITUS BASIS

Claim duration	% of NH terminations due to death	% of HHC terminations due to death
Months 1 through 3	52%	33%
Months 4 through 12	79%	54%
Year 2	87%	73%
Year 3	80%	76%
Year 4	72%	76%
Year 5	77%	75%
Year 6	83%	77%
Year 7	97%	86%
Year 8	97%	89%
Year 9	98%	92%
Year 10+	99%	92%

If a policyholder uses the maximum allowable benefits, that person's policy will terminate and is considered a benefit exhaust. Benefit exhausts are determined by the accumulated paid claims, which is based on the daily benefit amount, utilization assumptions, and other policy features. Benefit exhausts are calculated within the first principles model, so there is not an explicit benefit exhaust assumption. Policyholders with restoration of benefit provisions can go back into the active pool and have access to their full benefits, if the appropriate requirements are met before benefits are exhausted. Policies will terminate if the policy uses all of the benefits while on claim. The modeling of restoration of benefits and benefit exhausts should align with policy language and benefit administration.

OTHER MODELING CONSIDERATIONS

We discussed the major transitions and assumptions above, but other modeling complexities will arise that the actuary should consider in the first principles model, including:

- How to handle pending claims included in the in-force business at the valuation date—as active or disabled lives? What is the probability they will become open claims?
- What loads need to be added to the claim reserves for booking purposes, e.g., waiver of premium, incurred but not reported (IBNR), loss adjustment expense (LAE)?
- When modeling disabled lives (on claim at the valuation date), the model will also need to read in current claim duration, benefits paid to date, remaining benefit amount, etc.
- What ancillary benefits to model, such as waiver or premium, restoration of benefits, return of premium, etc.
- How to model nonforfeiture benefits and whether or not to embed them in the lapse rate assumption or explicitly model them separately.
- How incidence rates, mortality rates, and utilization rates change over time (e.g., incidence improvement or mortality improvement). This can be a significant assumption but is outside the scope of this paper.
- Whether to vary assumptions (claim terminations and incidence) by diagnosis. Credibility, run time, and modeling complexity should be carefully considered.
- How rate increases affect other assumptions, such as incidence and lapse rates.
- How the rate increase timing triggers associated benefit reduction options. An assumption for benefit reduction take rates should also be considered.

Once all the assumptions are loaded, the resulting first principles model will be able to create an income statement and the model can be used to perform cash flow testing. The company can now track open claims, incidence rates, active and disabled lives, active and disabled life mortality rates, and lapse rates over time. During a given month or quarter, the company can study whether open claims are higher or lower due to claims lasting longer or due to more or fewer new claims than expected. It can see whether policies terminate faster or slower than the model predicts, whether utilization came in as expected. Essentially the company can track and dynamically validate all inputted rates on a quarterly or monthly interval. Companies can look at the given gross premium reserve and component cash flows for individual policies and understand the drivers of reserve and cash flow changes by monitoring these statistics. Overall, this process allows for more refined tracking of policyholder status to determine the key drivers of emerging experience.

For us, building these reports for multiple companies and tracking the statistics in real time as quarterly earnings unfold has yielded opportunities to refine and customize the models. Creating various audits and seriatim outputs produced by these models has allowed us to spot problematic policy performance that may need to be corrected by rate actions or policy downgrade options. These audits and seriatim outputs have also allowed us to make sure the cash flows accurately reflect the policy and claim administration specified in the policy contract. The complexities associated with building a first principles model should not be underestimated, but neither should the value these models can add to the LTC industry.

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