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# Considerations Regarding Dynamic Lapses in Actuarial Modeling

A Public Policy Issue Paper



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**American Academy of Actuaries Life Experience Committee**

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# Introduction

In principle-based reserving (PBR), asset adequacy, and profitability testing, actuaries often need to develop assumptions for benefits where there may not be a lot of current data. Lapse (static and dynamic) is one such assumption.

There are many products where early-year lapses are detrimental, as the acquisition costs may not be covered if a contractowner lapses in the first few years. Conversely, there are some products where later lapses that are lower than anticipated could be detrimental to a company, as the later benefits could be more expensive to a company. A simple example is a level term product: Early lapses are typically bad, as the cost of commissions, underwriting, and administrative setups may not be amortized in the first few years, while later low lapses are bad for the company as more death benefits are paid out.

Products such as deferred annuities can have very dynamic lapses. The contractowner, having given the insurance company a large amount of money to invest, is typically sophisticated enough to be aware of interest rate movements and what alternative investment options exist if interest rates increase. If interest rates go up dramatically and lapses increase, the duration of the assets backing the deferred annuities may be longer than the duration of the liabilities. Likewise, in that scenario, the assets that may need to be sold to support the surrender may be worth less than when they were purchased, resulting in losses.

For many products, it is important to test the lapse assumption for a range of scenarios to better ensure that the lapse rates produced align with expectations. Once the dynamic lapse formula is established, it is important to monitor emerging experience and reflect new information as appropriate.

This issue paper explores items that impact lapses. It also discusses the impact of dynamic lapses on various life and annuity products, offers sample formulas for use in modeling, discusses how predictive analytics could be an alternative approach to model lapse behaviors, and provides sources of information on lapses—dynamic or otherwise.

## Understanding What Drives a Contractowner's Decision to Lapse

Inevitably, there will be some lapses in any insurance product that allows people to withdraw their money. For example, the contractowner may decide that the product is no longer needed or that they can no longer afford it. An insurance company will usually have significant experience with such expected, or baseline, lapse rates.

Of more interest to the actuary are unexpected, or dynamic, lapses. Primarily influenced by interest rates and/or equity market changes, they can also be influenced by negative corporate press or company downgrades.

Additional factors can influence the level of lapses experienced by a particular company when compared to another company in the same market and should be considered in developing a lapse function. Some of these factors include:<sup>1</sup>

- (1) The presence and level of any surrender charges. Many lapse rate functions consider the level of surrender charge relative to policyholder account values.
- (2) Rates credited on the policy versus rates available on similar products from other insurance companies or banks.
- (3) The marketing techniques and loyalty of the field force, possibly influenced by the effectiveness of the company's conservation program. The commission or compensation structure can influence a salesperson's prioritized resources or outreach.
- (4) Availability and accessibility of the information that gives the policyowner an understanding of the value of their guarantee and contract. Arguments have been put forth that participating business may be less sensitive to excess lapses, because the credited interest rate is not often obvious to the policyholder.
- (5) Distribution channel. Brokerage business may be more likely to lapse when compared to agent-sold business, due to more robust comparison shopping. The quality of the company's agency force may also affect persistency.
- (6) Duration from issue and policy size. Smaller size policies tend to have higher earlier-duration lapse rates, while larger policies have higher later-duration lapse rates.<sup>2</sup>

<sup>1</sup> Most of this section comes from Chapter 28 of *Statutory Valuation of Individual Life and Annuity Contracts*, Fifth Edition (2018).

<sup>2</sup> From SOA Exam LPM study note: LPM-107-07: Experience Assumptions for Individual Life Insurance and Annuities.

- (7) Type of products sold. Products that are primarily investment products, such as single premium deferred annuities, may be subject more frequently to excess lapsation than protection-oriented products. Additionally, products sold to institutions, such as bank-owned life insurance, will have different behavior than products sold to individuals.
- (8) Other guarantees available under the contract. For example, a variable annuity contract with a minimum guaranteed death benefit that is “in the money” will most likely have a lower propensity to lapse compared to an otherwise identical contract that is “out of the money.” A life contract that has secondary guarantees is also less likely to lapse.

## Information Needed in Developing a Lapse Functional Form

**Shape of the Lapse Function:** A dynamic lapse curve is typically half a U shape; there is little dynamism when the differences between market and crediting rates are relatively small but accelerates when the differences in rates increase. When there is little to no experience, judgment is needed to determine where this inflection point occurs and can be based on various factors.

**Maximum Lapse Rates:** Some companies will put a maximum on lapses, such as 40%, while others will allow maximum lapse rates to go to 100%. Note that to the extent a company does not have relevant and credible experience, certain states may specify by regulation excess lapse rates.

**Minimum Lapse Rates:** Some companies believe a minimum level of lapses will always be experienced, while others have actual experience showing that for some products, such as long-term care products, minimum lapse rates can approach or equal 0%.

**Competitor Rate:** To begin, the actuary must identify a company’s competitors. Then, it is necessary to define how rates should be set. For fixed account products, rates are typically set against a blend of Treasury rates or something similar. Some companies will study past credited interest rates and determine a scenario such as “105% x (50% of 5-year Treasury rates + 50% of 7-year Treasury rates) as the competitor rate. Determining the competitors’ rate needs to anticipate how quickly competitors will react to changes in interest rates. In 2022, experience with rising interest rates showed that there are some companies that can react quite quickly to a rise in rates.

## Sample Excess Lapse Function—Life Products

There are a variety of possible structures for excess lapse formulas. One such formula reflecting when competitor rates are different from the credited rates is found in the *Statutory Valuation of Individual Life and Annuity Contracts*.<sup>3</sup> This is discussed below:

$$\text{Excess } q_{[x]+t}^w = \frac{c}{1 + a \cdot e^{b[(i_t + SC_t^{FV}) - i_t^{\text{Competitor}}]}} - \frac{c}{1 + a \cdot e}$$

where

$$\begin{aligned} i_t^{\text{Competitor}} &= \text{competitor interest rate between durations } t \text{ and } t + 1; \\ &= z_{t,n} + d \\ z_{t,n} &= \text{spot for an } n\text{-year treasury at duration } t; \text{ and} \\ d &= \text{spread over Treasury rate.} \end{aligned}$$

In this particular example, it was assumed that

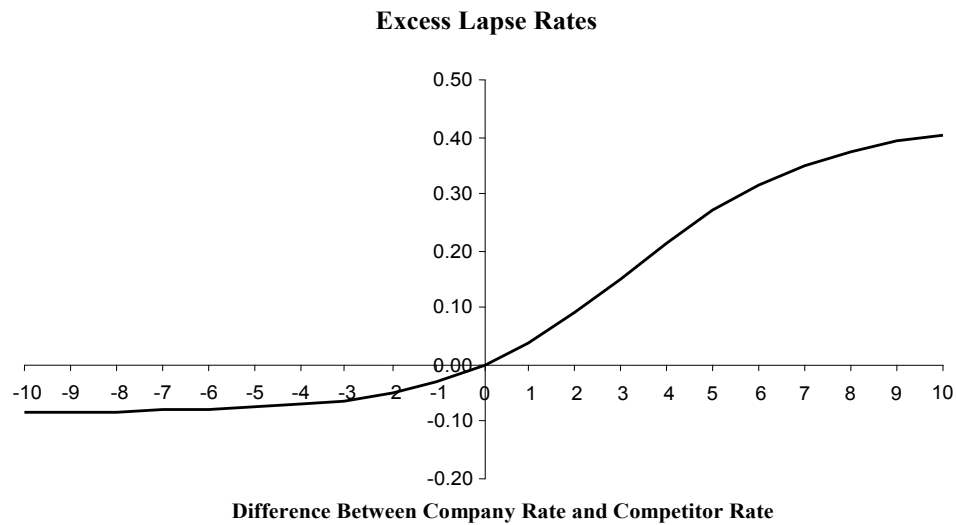
$$a = 0.2$$

$$b = -50.0$$

$$c = -0.5$$

$$d = 0$$

This formula for excess lapses adjusts the base lapse rate both up and down depending on whether the credited interest rate plus the surrender charge is lower or higher than the competitor rate, respectively:



<sup>3</sup> From Chapter 28 of *Statutory Valuation of Individual Life and Annuity Contracts*, Fifth Edition (2018).



## Alternate Sample Excess Lapse Function—Life Products

Excess lapse function can also take a simpler form where the dynamism is expressed in multiples of the base lapse rates, as seen below in an example of dynamic lapse assumption for an ULSG product.<sup>4</sup>

Lapse Rate = Rate from following table x Dynamic Lapse Adjustment

Year	Rate <sup>1</sup>
1	3.0%
2	3.0%
3	2.5%
4	2.5%
5	2.0%
6	2.0%
7	2.0%
8	2.0%
9	2.0%
10+	3.5%

<sup>1</sup> Lapses occur before annual premium due dates.

Dynamic Lapse Adjustment		
Account Value	Secondary Guarantee Status	Adjustment
Positive	Paid Up	50%
Negative	Paid Up	0%
Negative	Not Paid Up	50%

<sup>4</sup> Source: [Appendix C: Asset Modeling and Assumptions: Portfolio Earned Rates under Pricing Scenario; Impact of VM-20 on Life Insurance Product Development](#); Society of Actuaries; November 2016.

## Sample Dynamic Lapse Formula—Fixed Annuities

Companies may use dynamic lapse, or withdrawal, rates in determining renewal rates in order to make renewal rates more responsive to changes in the current interest rate environment. The dynamic lapse, or withdrawal, rates are usually based on a formula involving the competitiveness of the credited rates derived by the crediting strategy and the magnitude of the current surrender charges. An example of this is given in the SOA study note for the Life Product Management Exam.

$$a * (j - i - b) * (SV/AV) + c$$

or

$$a * (j - i)^b - c * SC + d$$

where

- j is the competitor's rate on new business,
- i is the current credited rate,
- SV is the surrender value,
- AV is the account value,
- SC is the surrender charge expressed as a percent of the account value and,
- a, b, c, d are constants

The appropriate values of a, b, c, and/or d will depend upon the other factors affecting the magnitude of the excess withdrawal rates such as the demographics of the contractholders, the marketing of the contract, and the perceived financial strength of the insurer.

Thus, the excess withdrawal rates appropriate for a very competitive SPDA marketed to high income professionals by a non-captive distribution network might not be appropriate for an SPDA, marketed as a retirement vehicle to middle-America by a captive agency force of a high quality insurer.

## Sample Dynamic Lapse Formula—Variable Annuities

Companies have found that a factor with significant impact on the lapses of variable annuities is the in-the-moneyness of any guaranteed benefits. In addition, the stock market level can also influence dynamic lapses.

### Example 1

The following lapse formula is used to determine the annual probability that a contract will terminate due to the policyholder electing to liquidate the entire contract.

$$\text{Lapse Rate} = \text{Max} \{ \text{Floor}; \text{Base Lapse Rate} \times \text{Dynamic Adjustment Factor} \}$$

where...

Floor = Reflects a level of lapse that occurs regardless of market conditions, etc.

Base Lapse Rate = Varies by duration of the contract (to reflect the impact of surrender charges), the type of contractual guarantee (GMDB only or GMDB and VAGLB), and whether the contract is under an automatic withdrawal option.

Dynamic Adjustment Factor = Increases or decreases the likelihood of lapse depending on the level of “in-the-moneyness” for the contractual guarantee.

$$\text{DAF} = \text{Min} \{ \text{Factor Cap}, \text{Max} [ \text{Floor Factor}; Y \times ((\text{AV}/\text{GV})^{\text{Power}}) ] \}$$

where the components vary by duration of the contract, type of contractual guarantee, whether the contract is under an automatic withdrawal option, and moneyness of the contract.

Factor Cap = Varies between 1.0 and 2.0.

Floor Factor = Varies between 0.5 and 1.0.

Y = Multiplier between 0.9 and 1.0.

AV = Account value of contract.

GV = Guarantee Value represents the value of the guarantee based on what is communicated to the policyholder on the quarterly statements. For GMDB only contracts it is the current guaranteed value payable upon death. For contracts with VAGLBs it is the withdrawal base.

AV/GV = Moneyness of the contract.

Power = Varies between 1.0 and 3.0.

## Example 2

This example used predictive analysis to determine lapse rates.

$$\text{Lapse Rate} = \text{Max} \{ \text{Floor}; Y \}$$

where...

Floor = 2% for GMDB only policies and 1% for policies with VAGLBs

$$Y = \exp(b_0 + b_1 \cdot X_1 + b_2 \cdot X_2 + \dots + b_p \cdot X_p) / [1 + \exp(b_0 + b_1 \cdot X_1 + b_2 \cdot X_2 + \dots + b_p \cdot X_p)]$$

Where Y represents the probability of lapse (ignoring the Floor) and is between 0 and 1.

$X_1, X_2, \dots, X_p$  are the data fields considered predictive, and  $b_0, b_1, \dots, b_p$  are the parameters resulting from the regression.

Predictive data fields include attained age, duration, tax status, in-the-moneyness level, rider specifics, payment status (e.g., automatic withdrawal elected), surrender charge, etc.

## Finding More Information From the Company

Sources of information within the company that could inform the level of lapses include:

- a. **Talking to the Sales Force:** Some company actuaries are involved in sales meetings. This offers the opportunity to discover what the contractowner is being told by the agent or broker. Insights can also come from the distribution force, which may stem from talking to policyholders or what the agent/broker sees in the broader industry landscape. Factors like the nature and impact of the ongoing distribution force contact can also impact customer loyalty and whether a product will lapse.
- b. **Contract, application, and prospectus:** The terms of the policies and contract can have a major impact on when lapses take place. For example, the surrender charge pattern will influence when customers choose to surrender a product. Ongoing communications, including what is on the annual policy summary, along with prominent displays of the guarantees, can be helpful.

- c. **Replacements:** Sometimes a company will determine that it is better to replace their own contracts with products that are slightly different.
- d. **Service Centers:** Some actuaries have found it useful to spend some time in the service centers. Customer service representatives speak with the contractowner and can provide insights into why customers may choose to surrender their product. Actuaries may find it helpful to listen to calls, review “why leave?” reports, and study call activity trends.

## Understanding the Definitions, Modeling Approach, and Their Potential Significance

An actuary who is setting up or reviewing a model should review several variables to understand the model. These include:

- a. **Granularity of assumptions:** This includes whether there are or should be different assumptions based on tax qualified vs. non-qualified, product type vs. generation, distribution channel, etc. There are implications of having more granular vs. aggregate assumptions.
- b. **Historical Experiences vs. Future Expectations:** Policyholders may become more efficient over time. Events could trigger changes in understanding of the product (e.g., newspaper articles, evolving views or requirements for advisers/sales force/company interactions), changes in administrative practices, etc. An actuary projecting future benefits must keep this in mind when setting the dynamic lapse function.

## Using Predictive Analytics to Model Dynamic Lapse Behaviors

Predictive analytics uses many of the core components of the traditional formulaic approaches described in the earlier sections of this paper, but has several advantages when compared to those techniques. Several advantages of predictive analytics for actuaries to contemplate are summarized below.

Predictive analytics techniques can solve the dilemma of the interplay between base lapses and dynamic lapses, where base lapses are required to estimate dynamic lapses, while dynamic lapses are required to estimate base lapses. It is possible to solve for base and dynamic lapses simultaneously with predictive analytics.<sup>5</sup>

By utilizing predictive analytics techniques, companies can also add increased granularity to their assumptions. For example, companies can introduce new factors (e.g., geo-demographic, type of underwriting) and evaluate their impacts without having to rely on traditional A/E results for increasingly smaller blocks of business, which would not be credible. It may also provide greater insight into the interaction of various factors, because it isolates the true effect of each factor by standardizing the effect of all other factors in the model.

The lapse assumptions produced by predictive analytics may also better serve other risk management processes. For example, with added granularity, it is possible to use predictive analytics to foresee which policyholders in a pool of inforce policies have a greater likelihood of surrendering or withdrawing. Better reinvestment opportunities may lead to higher withdrawals or surrenders from the inforce policy pool, but different policyholders may have different probabilities of taking such actions due to age, household income, health condition, and understanding of the economic movements. Companies can then focus on the relationship management with these policyholders, with the goal of reducing their chances of surrendering and thus reducing the company's overall liquidity risk.<sup>6</sup>

<sup>5</sup> Source: "[The Use of Predictive Analytics in the Development of Experience Studies](#)"; *The Actuary*; October/November 2015.

<sup>6</sup> Source: *Liquidity, capital, and ALM*; Milliman; Aug. 23, 2023.

## Sources of Information

Public information that speaks to dynamic lapses includes:

**SOA/LIMRA:** The SOA/LIMRA publishes periodic studies on lapses of various products. In some cases, more comprehensive data is available for purchase.

**Consulting Firms:** There are consulting firms that do extensive studies and may offer data on related websites. It can be assumed that more comprehensive information is available to their clients.

**Research Papers on Optimal / Efficient Behavior:** Companies can analogize and use insights from other industries and/or behavioral economics research (e.g., people who don't refinance their home mortgages) to determine a justifiable level of inefficiency. An example of such research is the 2014 report, [\*Modeling of Policyholder Behavior for Life Insurance and Annuity Products\*](#), published by the SOA.

*Statutory Valuation of Individual Life and Annuity Contracts*, specifically Chapter 19, Fifth Edition (2018), Volume 1, published by ACTEX.

## Summary

The considerations in this issue paper are intended to help an actuary understand the factors that influence dynamic lapses, including how efficiently a contractowner will behave when lapsing their policy. The paper also discusses how to develop dynamic lapse functions.

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