Sgt. Pepper Financial Group

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Our goal is to propose a new lapse rate formula to be used in the pricing model for Sgt. Pepper Financial Group's new fixed annuity product. We were given information regarding the characteristics and lapse rates of an older fixed annuity product and the characteristics of the new product. The historical data was organized by issue years 1981, 1990, and 1993. The Experience Studies division recommended nine factors, and we selected the four most important factors to be used in the formula projecting lapse rates for the new product.

Evaluation of Factors Affecting Lapse Rate

The nine recommended factors were not targeted towards fixed annuity products, so it is necessary to evaluate which will have the biggest impact on fixed annuity lapse rate. Initially, we tested for the correlation strength between lapse rate and each of the nine factors in the historical data using scatter plots. The graphs revealed very little correlation between lapse rate and any of the factors. In addition, we used a Seaborn heatmap in Python to test the relative correlation strength between lapse rate and each of the other factors (Figures 1-3). The results were inconsistent across the different issue years.

To supplement the correlational analysis, we relied on researching the practices of other insurance companies. We found that many dynamic lapse rate formulas used surrender charges, crediting rates, and market (or competitor) rates. Because both fixed annuities and bonds are relatively low-risk investment options, market rates can be estimated using a blend of treasury rates.[1] Therefore, we feel that surrender charges, crediting rates, 5-year treasury rates, and 10-year treasury rates are the most influential on lapse rates. We expect lapse rates to be lower during the surrender charge period since the surrender charge affects how much of their contract's value a customer can regain. Crediting rates and competitor rates affect whether a customer lapses to get a better deal.

Lapse Rate Formula

We found a few sample dynamic lapse rate formulas during our research[2]:

1. $a * (MR - CR)^b - c * SC + d$
2. $a + b * e^{c*CR/MR}$

Where CR = Crediting rate

MR = Market/competitor rate

SC = Surrender charge

a, b, c, d = coefficients

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[1] https://www.actuary.org/sites/default/files/2023-12/life-paper-dynamic-lapses.pdf p.3

[2] https://www.actuary.org/sites/default/files/2023-12/life-paper-dynamic-lapses.pdf p.6; https://essay.utwente.nl/61317/1/MSc_CZ_Michorius.pdf p.27

These sample equations reinforce our selection of factors. We were particularly interested in Equation 1 since it was specifically an example of a dynamic lapse model for fixed annuities. We are given the crediting rates and surrender charges and can estimate the competitor rate using treasury rates. The coefficients are selected based on other factors such as policyholder demographics, and marketing. Because the coefficients rely on a variety of factors that we do not have access to, we decided to use an alternative model.

We decided to use multiple linear regression for its simplicity. We regressed lapse rate against surrender charge, crediting rate, 5-year treasury rate, and 10-year treasury rate. We came up with the following formula:

$$Lapse\ Rate = 0.13212 - 0.86167(CR) - 0.14611(5Y\ TR) + 0.82539(10Y\ TR) - 1.08116(SC)$$

Applying this model to the data of the new product resulted in the projected lapse rates shown in Figure 4. The next step would be to incorporate base lapse into our model. From our research, we expect the base lapse during the surrender charge period to be around 3%, the base lapse during the shock year is around 35-38%, and the base lapse after the shock year is 10-12%.[3]

Lapse Formula Enhancement for Guaranteed Living Benefit (GLB)

We needed to consider the possibility of a GLB feature being added to the product later. Guaranteed living benefits are offered as riders to annuity contracts for an extra charge. These riders include Guaranteed Minimum Income Benefit (GMIB), Guaranteed Minimum Accumulation Benefit (GMAB), Guaranteed Minimum Withdrawal Benefit (GMWB), and Guaranteed Lifetime Withdrawal Benefit (GLWB). Based on our research on these riders, we found two factors that would affect lapse behaviors if a GLB feature is added: in-the-moneyness and policyholder age. In-the-moneyness is equal to the withdrawal base, which determines the minimum guaranteed annual withdrawal amount, over the account value, and is an indication of how much policyholders are being allowed to withdraw in comparison to initial investment. The more in-the-money a policyholder, the less likely they are to lapse. Lastly, policyholder age is a factor that would affect the lapse formula, as older policyholders are less likely to take risks on their investments, compared to younger policyholders who might lapse so that they can use their money in other investment areas.[4]

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3 https://content.naic.org/sites/default/files/inline-files/DFS%20Dynamic%20Lapse%20Comparison%20-%20SCL%20vs%20Academy%20vs%20NAIC%20Drafting%20Group%2012%2013%202023%20%281%29.pdf p.2; https://www.milliman.com/-/media/milliman/importedfiles/ektron/fixed-indexed-annuities-2018-survey.ashx p.3

4 https://www.milliman.com/-/media/milliman/pdfs/articles/valueslapsestudy2019_summary_milliman.ashx?la=en&hash=5D5F7CFD8D1F2FC34C3D054A9E36AF6F p.1-2

Appendix

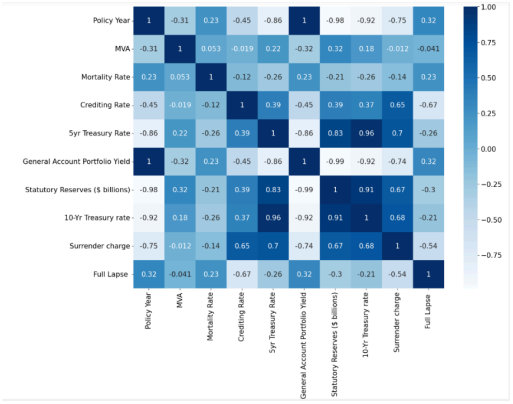

Figure 1: 1993 Issue Year Heatmap

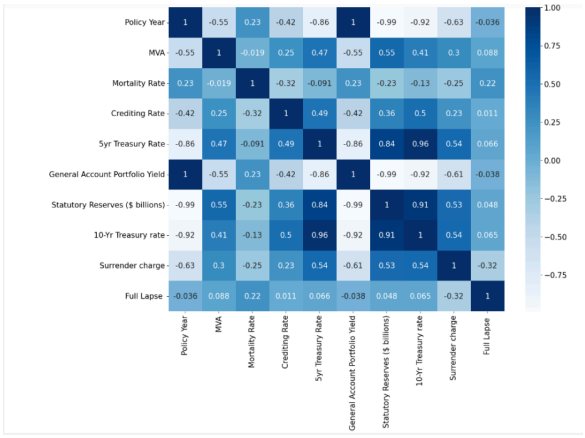

Figure 2: 1990 Issue Year Heatmap

Figure 3: 1881 Issue Year Heatmap

Crediting Rate	5-Yr Treasury Rate	10-Yr Treasury rate	Surrender charge	Projected Lapse
4.50%	4.07%	3.96%	12%	0.23%
4.50%	3.70%	3.95%	10%	2.32%
4.50%	3.83%	4.00%	10%	2.39%
4.70%	4.07%	4.19%	7%	5.65%
4.80%	4.25%	4.28%	5%	7.83%
4.80%	5.11%	4.93%	4%	9.56%
5.00%	5.10%	5.07%	3%	10.59%
5.00%	5.70%	5.64%	2%	12.23%
5.00%	6.20%	5.80%	0%	14.60%
5.20%	5.90%	5.50%	0%	14.13%
5.20%	5.99%	6.16%	0%	14.69%
5.50%	6.10%	5.90%	0%	14.23%
5.50%	7.50%	7.42%	0%	15.70%
5.50%	7.00%	6.60%	0%	14.94%
5.50%	7.70%	7.00%	0%	15.38%

Figure 4: Projected Lapse for New Product