Luvalle Life Insurance Company

Executive Summary

Team 25

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Brief Overview

An actuarial analyst in Luvalle Life Insurance Company Annuity Division performed a sensitivity analysis on the SPIA present value (PV) of benefits for six scenarios: best estimate, mortality shock, mortality improvement shock, interest rate hike, interest rate decrease, and a 0% interest rate shock. After cleansing the given data by adjusting entry errors and removing outliers, the clean data was fed into the provided model to calculate the PV benefits for the six different scenarios. Using the best estimate scenario as a base case, the PVs of the other five scenarios were compared against the PV of the base case. In addition to calculating the benefits, a 0% rate shock sensitivity analysis was also performed on the current SPIA investment portfolio along with 2 alternative portfolios. Portfolio selections were analyzed taking into consideration the SPIA liability and their respective duration along with the impact of interest rate movements on their value. Furthermore, the results from the sensitivity analysis were used to forecast any impact on an enterprise-wide level. Analysis on key risks affecting Term Life Insurance, Indexed Universal Life Insurance, and Variable annuities were also provided.

Analyzing the Data

Obvious data issues were detected by adding a “Filter” to each column. Column “Pol_St” values = NA were removed. Column “Iss_Yr” values = 17 were changed to 2017. Similarly, column “Birth_Yr” values = 55 were changed to 1955. Column “Iss_Age” values = 0 were calculated with the difference between October 5, 2020 and their respective birthdate. Column “Pol_Num”, “Issue_Mo”, “Issue_Day”, “Birth_Mo”, “Birth_Day”, “Sex”, and “Att_Age” did not contain any issues. Pivoting to more subtle data issues, the SPIA pays the modal benefit depending on the mode, so the Yearly Payment was the product of “Mode” and “Modal_Ben”. The single premium “Sing_Prem” was graphed against the Yearly Payment to check for any trends or discrepancies. There is a clear positive linear trend between the single premium and yearly payment, which is intuitive as the policyholder pays more money upfront to receive more money later. An inverse relationship also appears for modal benefit and mode. However there are a few outliers that were removed as their yearly payment amount is more than the yearly payment of similar single premium amounts.

Sensitivities

Using the best estimate as the base case, we expect the SPIA’s PV to increase when there is mortality shock. Similarly, the PV is also expected to increase when there is a mortality improvement shock. Furthermore when the interest rate increases, we can expect the PV to decrease. On the other hand when interest rate decreases, the PV is expected to increase. Similarly if rates were to decrease down to 0%, the PV is expected to increase even more. All of our assumptions were proven correct after the model produced the PVs. To validate the results, the SPIA’s liabilities increase as there are more benefit payments to be made for longer living

policyholders, thus the PV of benefits increases as mortality rates decrease. In addition, as interest rates decrease and fall down to 0%, the benefit payments in 10 years are worth the same today, thus there is no discount to those payments.

SPIA Bond Portfolios

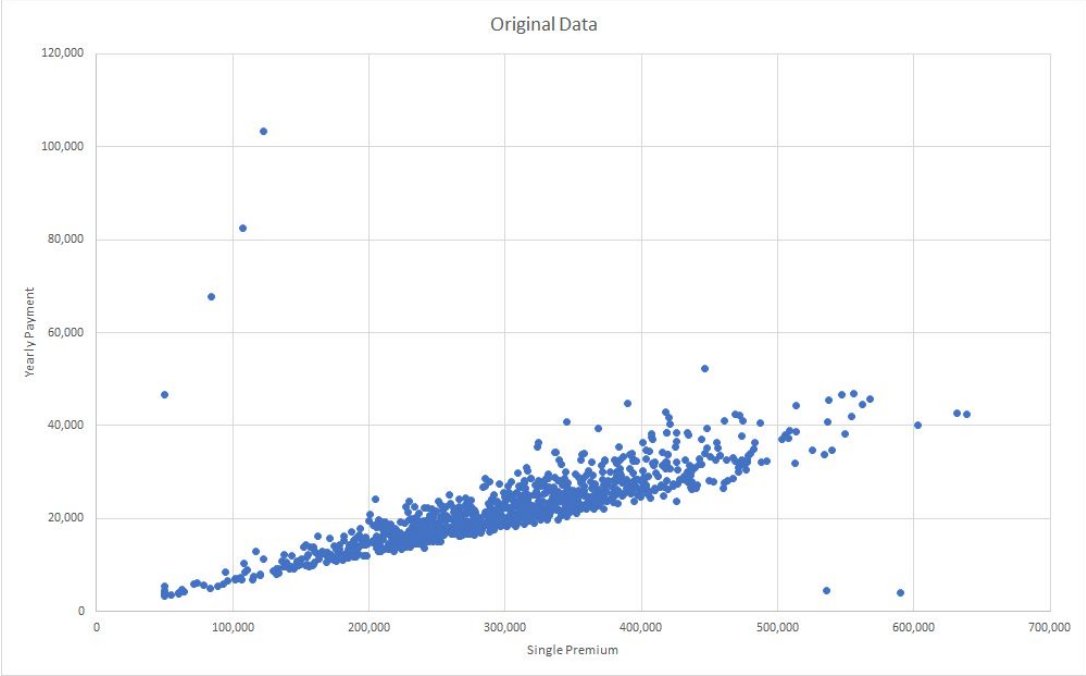
We performed a duration and convexity calculation to estimate the portfolio value based on the shifts in interest rate. The duration calculation does not account for rate of change while the convexity calculation accounts for non-linearity changes, thus it is more accurate. Without specific cash flows such as coupon/dividend rates and the individual interest rates of each bond, it proved difficult to find an exact estimate as the calculation needed those inputs. In addition, our estimate may be not completely accurate as there may be embedded options written into the bonds, such as callable provisions or put provisions, that may affect the portfolio value.

The sensitivity analysis on the current investment portfolio was found to have beneficial hedging potential risks as well as asset and liability matching due to its duration. However it is the most sensitive to interest rate fluctuations, but it is the best pick if a low interest rate environment is expected. Alt 1 portfolio offers a less sensitive reaction to fluctuation in interest rate shocks. It is suitable if there is uncertainty for future direction of interest rates. Alt 2 portfolio is the least sensitive due to its short duration, but it is adverse to an low interest rate environment. If interest rates are expected to increase, Alt 2 is a suitable option. Factors such as economic recessions, interest rate risk, climate change consequences, natural catastrophes, and political risks should be considered before making a final decision going forward.

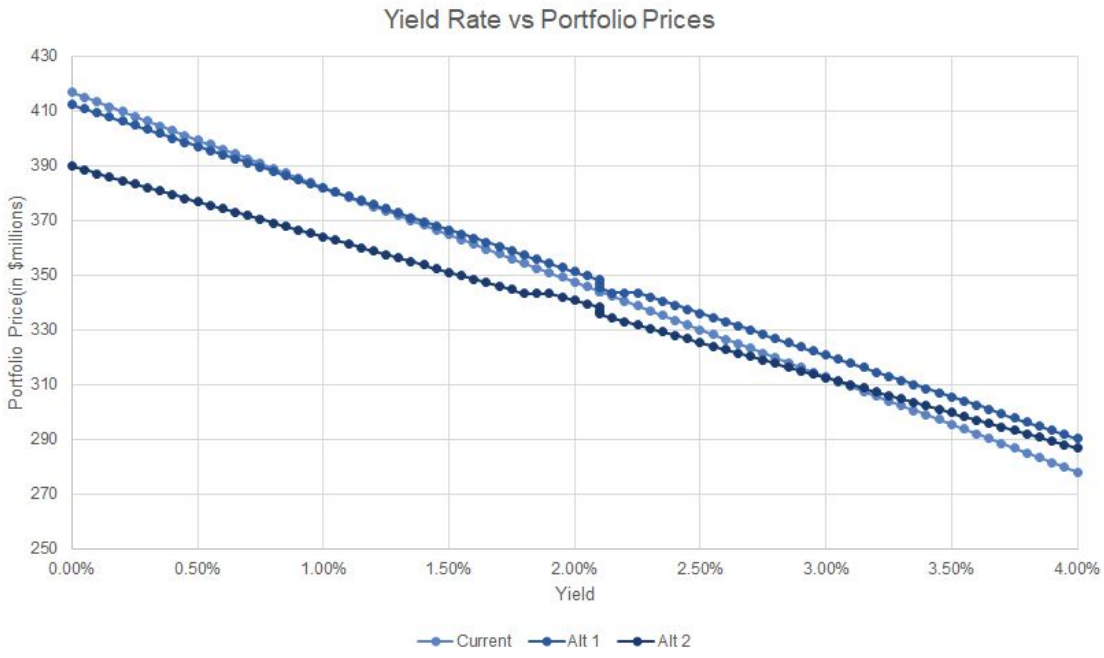
Enterprise View

As a life insurance company, liquidity and assets are always influenced by changing the interest rate. As part of asset-liability management, it is important to match the liability cash flow and asset cash flow to avoid setting up an additional asset-liability mismatch under different scenarios. Interest rate change may impact the company in multiple ways. For example, under a low rate environment, there may be depressed crediting rates, potentially decreasing the insurer's future obligation to policies. Low credit rates will also reduce the attractiveness of the interest rate sensitive product as well. This will decrease products that can sell with less premium we can collect for the other investments. On the asset part of the balance sheet, we need to face the challenge of structuring a new investment portfolio to meet the future obligation on policies written.

These policies need to adequately address the risks associated with them. The term life insurance often has risks involving coverage renewments which may be harder to find or more expensive as people age. The Indexed Universal Life Insurance is based on the performance of the index fund and therefore reliant on market performance. A Single-Premium Immediate Annuity's premiums are irrevocable, meaning that they cannot be taken back during emergencies. With the Variable Annuity, it may be difficult to hedge against since the Greeks are difficult to determine. Thus, the less accurate the estimate, the more the guarantee will remain unhedged.



Scenario	Best Est	Mort Shock	MI Shock	Rates Up	Rates Down	Rates o%
12/31/2020	$333,748,917	$344,104,431	$335,459,402	$300,541,726	$373,365,795	$400,874,084



$$\text{Effective Convexity} = \frac{P_i + P_d - 2P_0}{2 \times P_0 \times \text{deltaY}^2}$$

$$\text{Change in Bond Price} = -D \times \text{deltaY} + \frac{\text{deltaY}^2}{2} \times \text{Convexity}$$