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Luvalle Life Insurance Company
Executive Summary
Team 32

Data Quality

To ensure data integrity, we performed data explorations. First, we observed that there are duplicates in the policy numbers, and we removed them. We also checked the validity of issue age and attained age for each policy. We discovered some errors on the birth year because it is not reasonable to have the birth year being later than the issue year. We fixed the error by calculating the correct birth year using the provided attained age. There also exist some inconsistencies between the benefit amounts and the single premium amount. We performed the outlier analysis by using standardized residuals to check for outliers. We removed these outliers whose standardized residuals are larger than 3 units. The resulting correlation coefficient is much higher than the original dataset, which indicates that the exclusions of these outliers are reasonable. The final dataset contains 993 policies, which will feed into the projection model for the following sensitivity analysis.

SPIA Sensitivity Analysis

The Single Premium Immediate Annuity (SPIA) provides retirement protection by paying level benefits until an annuitant's death. SPIA policies are funded with a single upfront premium. Two factors impact the present value of future liabilities stemming from an SPIA policy: mortality rate and interest rate. As mortality rates decrease, the present value of the SPIA increases because policyholders live longer and receive more benefit payments. Similarly, rising mortality improvement will cause the present value of the SPIA to go up. Our model assumes a constant mortality improvement each year, rather than a time series vector in the Lee-Carter model, which we believe is unnecessarily complex considering that the present value is extremely insensitive to mortality improvement changes. The present value is slightly sensitive to a mortality shock; scaling the mortality rates to 90% results in a 3% increase in total present value.

As interest rates rise, the present value of an annuity falls because money accumulates faster. The results show that our present value prediction is very sensitive to changes in the interest rate. A one percent change in the interest rate changes all policies' total present value by 10-12%. Because of these sensitivities, we suggest that the team immunize these changes using mortality-interest duration matching strategies, which outperform strategies using only the force of mortality or only the force of interest. We also saw that older policyholders have initial benefits that are more sensitive to mortality yet less sensitive to the interest rate. Therefore, we should take into account the demography of policyholders when formulating our immunization strategy.

SPIA Asset Portfolio

Our SPIA asset portfolio supplements the premiums to back up the SPIA liabilities. To better immunize the SPIA liabilities, we should try to match its duration with our assets' duration.

The SPIA block has a duration of 11.0 years. Our current portfolio has a duration of 10.1 years, which is the closest to hedge against interest rate risk. The first alternative portfolio has a lower duration of 8.9 years, and we may lose around 3% of the value from reduced credit rating. The second alternative significantly shifts toward shorter-term bonds and has a duration of 7.5 years. If we think interest rates will rise in the future, it may seem better to use an alternative portfolio with shorter-term bonds, but since our goal is to immunize against the SPIA liability, it would actually make more sense to increase the duration of the asset portfolio.

As stated earlier, to effectively hedge against interest and mortality risk, we should include both longevity bonds and fixed-income securities in our portfolio.

Enterprise View

Luvalle Life Insurance Company has four main product lines: Term Life Insurance, Index Universal Life Insurance, Single Premium Immediate Annuity, and Variable Annuity. Each product line has its key risks that need to be analyzed.

Term Life Insurance's key risk is liquidity risk, where the maintenance of a sufficient level of cash to pay the death benefits should be monitored closely. To manage liquidity risk, the company should implement liquidity risk control as well as monitor the liquidity risk profile to maintain adequate cash flow amounts.

Index Universal Life Insurance's key risk is Asset Liability Management risk, where the asset of the single upfront premium needs to cover the liability of level benefits of the insured. One possible solution for the Asset Liability Management risk is reinsurance, a way to mitigate losses.

One potential risk for variable annuities is market risk, which refers to the impacts on guaranteed payments or required reserve levels caused by market factors changes. Equity and interest rate risk are two main market risks for Variable Annuity. A decrease in equity price and changes in interest rate will result in a decline in the policyholder's account values, which will affect the policyholder's ability to cover the payments. One possible solution to manage the variable annuity is to construct a diversified portfolio using futures, bonds, and options.

One key risk for the single premium immediate annuity is the longevity risk. Longevity risk involves unexpected mortality assumptions. Possible solutions include redesigning products with age restrictions on receiving benefits and on income commencement. Another way to manage longevity risk is to use risk pooling and product diversification.
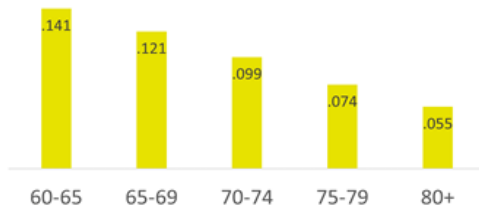
Tables and Graphs

Nominal Benefit vs Premium
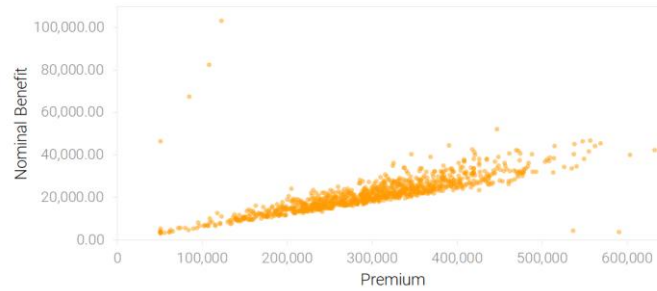
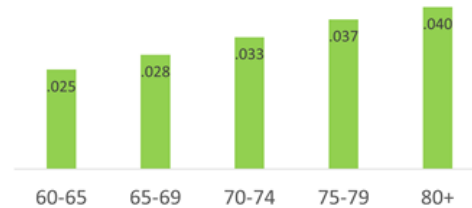Nominal benefit is highly correlated with premium.

Sensitivities as percent change in PV

Mort	MI	RU	RD	0%
0.031	0.005	-0.099	0.119	0.201

*The table above shows sensitivities of the entire SPIA block.

As age increases, interest sensitivity decreases while mortality sensitivity increases.

Asset Portfolio Sensitivities

Portfolio	Baseline PV	0% PV	0% Rating Adj PV
CURRENT	343m	453m	445m
ALTERNATIVE 1	343m	436m	422m
ALTERNATIVE 2	343m	400m	396m

The table shows the PV of each portfolio if we set the interest rate to 0%. The right column adjusts for the possibility of defaults, based on the credit ratings of the bonds.