2021 UCLA Case Competition

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Table of Contents

01 DATA EXPLORATION
02 SENSITIVITY ANALYSIS
03 ASSET PORTFOLIO
04 ENTERPRISE VIEW & KEY RISKS
01 Data Exploration
Data Quality

● Issue 1: Policy duplicates.
  ○ Adjustment: removed the duplicates.

● Issue 2: Birth year being later than issue year.
  ○ Adjustment: recalculated the birth year according to the given attained age.
Data Quality (Cont.)

- **Issue 3**: Inconsistencies with benefit amounts and single premium.
  - **Adjustment**: removed the outliers.

### Nominal Benefit vs Premium

**Before adjustment**

**After adjustment**
02 Sensitivity Analysis
Sensitivity Expectations

Sensitivity Factors

- Two factors: mortality rate and interest rate
- Decreasing mortality (increasing mortality improvement) = increasing PV
- Increasing interest rate = decreasing PV

Time Expectation

- Sensitivity increases with later projection dates
- More time for money to accumulate, greater mortality improvement

Assumptions About Mortality

- Lee-Carter model for non-constant mortality improvement is unnecessary
Sensitivity Results

PV of total benefits

\[
\% \Delta PV = \frac{PV^* - PV_{BE}}{PV_{BE}}
\]

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Best Est</th>
<th>Mort Shock</th>
<th>MI Shock</th>
<th>Rates Up</th>
<th>Rates Down</th>
<th>Rates 0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proj Year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>332m</td>
<td>343m</td>
<td>334m</td>
<td>299m</td>
<td>372m</td>
<td>399m</td>
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<tr>
<td>2030</td>
<td>159m</td>
<td>168m</td>
<td>160m</td>
<td>133m</td>
<td>189m</td>
<td>212m</td>
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<tr>
<td>2040</td>
<td>51m</td>
<td>57m</td>
<td>52m</td>
<td>40m</td>
<td>65m</td>
<td>76m</td>
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<tr>
<td>2050</td>
<td>7.4m</td>
<td>9.2m</td>
<td>7.7m</td>
<td>5.4m</td>
<td>10.3m</td>
<td>12.6m</td>
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<tr>
<td>2060</td>
<td>251k</td>
<td>404k</td>
<td>263k</td>
<td>166k</td>
<td>380k</td>
<td>488k</td>
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<tr>
<td>2070</td>
<td>1.5k</td>
<td>4.0k</td>
<td>1.5k</td>
<td>0.9k</td>
<td>2.4k</td>
<td>3.3k</td>
</tr>
</tbody>
</table>

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

- For a given projection date, older policyholders’ benefits are less sensitive to interest rate.
- Yet they are more sensitive to mortality rate.
03 Asset Portfolio
Comments on Asset Sensitivities

Assumptions

- To estimate the sensitivities, we assumed the future cash flows were fixed, and discounted back by the different yield rates to get PV
- Term structure of interest unknown
- 0% interest rate unlikely
- Sensitivities of liabilities should drive assets!

Credit Rating Factor

- Using data from S&P Global, we ran SLR to model default probability versus year, for each credit rating
- For BBB rated bonds, probability of default increases by 0.31% each year

Default Factor

<table>
<thead>
<tr>
<th>Credit Rating</th>
<th>Default Factor</th>
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<tbody>
<tr>
<td>AA</td>
<td>0.08%</td>
</tr>
<tr>
<td>A</td>
<td>0.13%</td>
</tr>
<tr>
<td>BBB</td>
<td>0.31%</td>
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</table>
## 0% Shock Results

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Baseline PV</th>
<th>0% PV</th>
<th>0% Rating Adj PV</th>
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</thead>
<tbody>
<tr>
<td>CURRENT</td>
<td>343m</td>
<td>453m</td>
<td>445m</td>
</tr>
<tr>
<td>ALTERNATIVE 1</td>
<td>343m</td>
<td>436m</td>
<td>422m</td>
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<tr>
<td>ALTERNATIVE 2</td>
<td>343m</td>
<td>400m</td>
<td>396m</td>
</tr>
</tbody>
</table>
Review of Each Portfolio

- CURRENT: Duration of 10.1, high-grade bonds (2% loss)
- ALTERNATIVE 1: Duration of 8.9, medium-grade bonds (3% loss)
- ALTERNATIVE 2: Duration of 7.5, high-grade bonds (1% loss)

Problem
Only fixed-income securities to back SPIA

Solution
Purchase longevity bonds

SPIA Duration
11.0
04 Enterprise View & Key Risks
Term Life Insurance

Liquidity Risk:

- Risk of not having sufficient cash to pay out claims

Possible Solution:

- Implement liquidity risk control
- Monitor liquidity risk profile
Index Universal Life Insurance

Asset Liability Management Risk:

- Make sure investment income is more than total liabilities

Possible Solution:

- Reinsurance
Variable Annuity (VA)

Market Risk:

- Equity Market Risk
- Interest Rate Risk

Possible Solution:

- Diversified portfolio (futures, bonds, options)
Single Premium Immediate Annuity (SPIA)

Longevity Risk:

- Mortality assumptions are not as expected
- Policyholders live longer than expected

Possible Solution:

- Design products with age restrictions on both receiving guaranteed benefits and on income commencement
- Risk pooling and product diversification
Thank You for Listening !