2021 BAS Annual Case Competition

Team 18:
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Agenda

1. Sensitivity Analysis Objective
2. SPIA Sensitivity Testing
3. SPIA Asset Portfolio
4. Business Impact
Sensitivity Analysis

Objective

What do we gain from this project?
Motivation

● Why is this needed?
  ○ To protect Luvalle
  ○ Analyze our risk profile
  ○ Set strategy in low rate environment
## Risk vs. Reward

<table>
<thead>
<tr>
<th></th>
<th>Risk</th>
<th>Reward</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term Life</td>
<td>Lower</td>
<td>Lower</td>
</tr>
<tr>
<td>Indexed Universal</td>
<td>High, indirectly depends on stock market</td>
<td>Potentially high or low</td>
</tr>
<tr>
<td>Single Premium</td>
<td>Lower</td>
<td>Lower</td>
</tr>
<tr>
<td>Variable Annuity</td>
<td>Higher, directly depends on stock market</td>
<td>Potentially high or low</td>
</tr>
</tbody>
</table>
What are potential risks for our SPIA product?
Data Quality:
Inconsistencies Within Fields

<table>
<thead>
<tr>
<th>Iss_Age</th>
<th>Pol_Sts</th>
<th>Iss_Yr</th>
<th>Birth_Yr</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>PD</td>
<td>2016</td>
<td>1940</td>
<td>12</td>
</tr>
<tr>
<td>0</td>
<td>PD</td>
<td>17</td>
<td>2055</td>
<td>2</td>
</tr>
<tr>
<td>67</td>
<td>NA</td>
<td>2015</td>
<td>2055</td>
<td>1</td>
</tr>
<tr>
<td>66</td>
<td>NA</td>
<td>2018</td>
<td>2055</td>
<td>12</td>
</tr>
<tr>
<td>67</td>
<td>AC</td>
<td>2020</td>
<td>1960</td>
<td>2</td>
</tr>
</tbody>
</table>

See Appendix for details
Data Quality: Relationships Between Fields

- Checked Iss_Age and Att_Age were accurate as of 12/31/2020
- Noticed unusually high and low benefits

See Appendix for details
## Sensitivity Expectations vs Results
*(Trends in Comparison to Best Estimate)*

<table>
<thead>
<tr>
<th></th>
<th>Best Estimate</th>
<th>Base Mortality Shock</th>
<th>MI Shock</th>
<th>Rates Up</th>
<th>Rates Down</th>
<th>Rates 0%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expectations (millions)</strong></td>
<td>$333</td>
<td>$344</td>
<td>$335</td>
<td>$300</td>
<td>$373</td>
<td>$400</td>
</tr>
<tr>
<td><strong>Results (millions)</strong></td>
<td>$333</td>
<td>$333</td>
<td>$335</td>
<td>$300</td>
<td>$373</td>
<td>$400</td>
</tr>
</tbody>
</table>
Projected PV Benefits Runoff

PV Benefits (Millions of Dollars)

Year

- Best Est
- Mort Shock
- MI Shock
- Rates Up
- Rates Down
- Rates 0%
Sensitivity Impact on PV Benefits

Difference from Best Estimate

-15.00%
-10.00%
-5.00%
0.00%
5.00%
10.00%
15.00%
20.00%

Sensitivity

Least Sensitive
Most Sensitive

MI Shock
Mort Shock
Rates Up
Rates Down
Rates 0%

0.51%
3.11%
-9.93%
11.85%
20.07%
Analyze Past Data

Compare trends with results

Improve Model Accuracy

Validation Methods
How can we make investments to back up liabilities under the low interest rate environment?
Objectives:

3 portfolios:

Current portfolio

Alternate 1

Alternate 2

Lower credit rating, shorter tenors

Same credit rating, much shorter tenors

0% interest rate shock

Appropriateness for backing the SPIA Liability

Other sensitivities before making final decision
Implications from 1% rate shock

Amount invested: $342.7m

Bond Price (Millions of Dollars)

390
380
370
360
350
340
330
320
310
300

Rates Up 1%
No Change
Rates Down 1%

Interest Rate

Current
Alternate 1
Alternate 2
# 0% Rate Shock Estimate

Interest Rate $\downarrow$ Bond Price $\uparrow$

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Duration</th>
<th>Baseline Yields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>10.1</td>
<td>2.1%</td>
</tr>
<tr>
<td>Alternate 1</td>
<td>8.9</td>
<td>2.25%</td>
</tr>
<tr>
<td>Alternate 2</td>
<td>7.5</td>
<td>1.8%</td>
</tr>
</tbody>
</table>
Key Ideas:

If interest rates decrease by x%, then bond prices increase by (Duration * x) %.  

Baseline Yields ⇔ Interest Rate

Resulting Formula for 0% rate Shock:

New Bond Price = Initial Bond Price * [ 1 + (Baseline Yields * Duration) ]
Interest Rate Sensitivities with 0% Rate Shock

- **Current**
- **Alternate 1**
- **Alternate 2**

Bond Price (Millions for Dollars)

- Rates Up 1%
- No Change
- Rates Down 1%
- 0% rate

Interest Rate
Possible Inaccuracies

- 0% interest rate may not mean that the interest rate is literally 0.

- Change in bond price given a 1% change in interest rate does not exactly match the duration.
Which portfolio?

Factors to Consider

- Sensitivities
- Yields
- Bond Maturity
- Credit Quality
- Expectations for the Future

Bond Maturity

Credit Quality

Sensitivities

Yields

Expectations for the Future
Current Portfolio
- Majority 20y bonds
- High credit quality

Drawbacks:
- If interest rates decrease -> lose more money
- Majority of returns in far future
- Most sensitive to interest rate changes

Alternate 1
- Most yields
- Majority 10y bonds
- Medium credit quality

Drawback:
- Highest default risk (5%)

Alternate 2
- Least sensitive
- Majority 5y bonds
- High credit quality

Drawbacks:
- Least yields
- If interest rates increase -> higher opportunity cost for short-term bond
Other Possible Sensitivities for Bond Price

- Inflation Rate
- Term to Maturity
- Credit Quality
- Inflation
Business Impact

How can we best protect Luvalle against risk?
Enterprise-Wide Recommendations
Thank you!
## Appendix

<table>
<thead>
<tr>
<th>Policy Deleted</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPIA00164, SPIA00346, SPIA00295</td>
<td>Birth Year was 2055</td>
</tr>
<tr>
<td>SPIA00740, SPIA00086</td>
<td>Policy Status was NA</td>
</tr>
<tr>
<td>SPIA00952, SPIA00953, SPIA00954, SPIA00955, SPIA00956, SPIA00957</td>
<td>Issue Age was 0</td>
</tr>
<tr>
<td>SPIA00272, SPIA00298, SPIA00725, SPIA00928</td>
<td>Duplicates</td>
</tr>
</tbody>
</table>

Additional Changes:
- Changed 104 policies to reflect annual payments instead of biannual payments
- Changed Att_Age so they all reflect age as of 12/31/2020
- Changed formatting in Iss_yr from 17 to 2017