Ninth Annual Bruins Actuarial Society Case Competition

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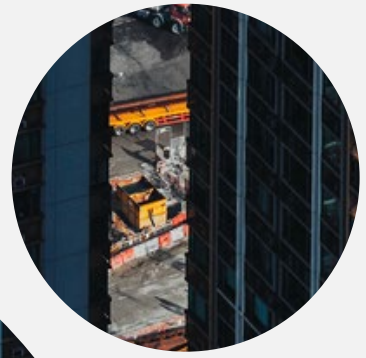
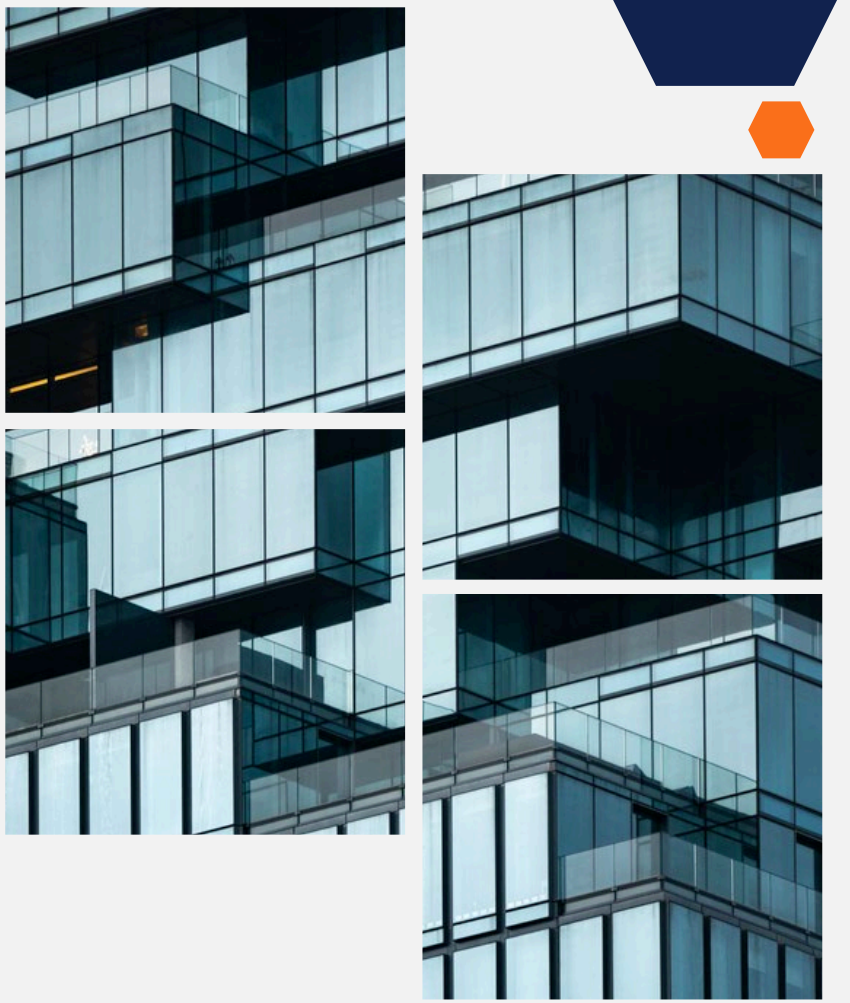
Agenda

- Enterprise Perspective
- Product Line Risks
- Data Quality
- Sensitivity Expectations
- Sensitivity Results
- Methodology for Bond Summary
- o% Shock on SPIA Asset Portfolio
- Factors to Consider
- Appropriateness of Portfolio
- Appendix



Enterprise Perspective

- Liability and Asset Sensitivity Analysis
- Impact of Different Interest Rates on
  - Asset-liability mismatch
  - Obligation to policies
  - Product



Product Line Risks

Term Life

Least Risk

- Risk of policyholders not paying premium
- Few assets backing liability reserves

IUL

Less Risk

- Long term growth of index
- Equity liability

SPIA

Less Risk

- Dynamic hedging
- Adverse selection

Variable Annuity

More Risk

- Unreliable hedging
- Exotics availability
- Greeks accuracy
- RBC requirement changes

Data Quality

ASOP No 23 3.1

- *"…Identify data values that are questionable or relationships that are significantly inconsistent."*

Minor Issues

- Data Entry Errors in "Issue Year" = 17
  - Changed to 2017
- "Pol_Sts" = NA
  - Changed to AC
- "Birth_Yr"= 2055
  - Changed to 1955
- "Iss_Age" = 0
  - Calculated new Issue Age from birthdate

Normal Data

- No issues identified with month/day of issue & sex

Relationships in Data

- Modal Benefit α 1/Mode
- Modal Benefit α Single Premium

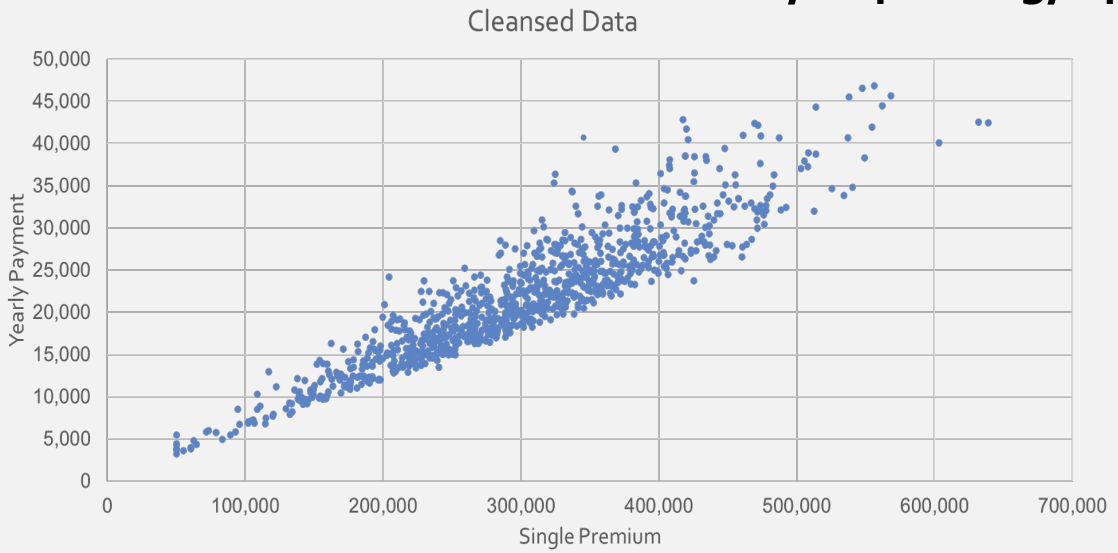
Data Quality

Inconsistent yearly payment

- Yearly payment= Modal • Modal Benefit
- Yearly payment amounts far outpacing single premium
- SPIA00323:

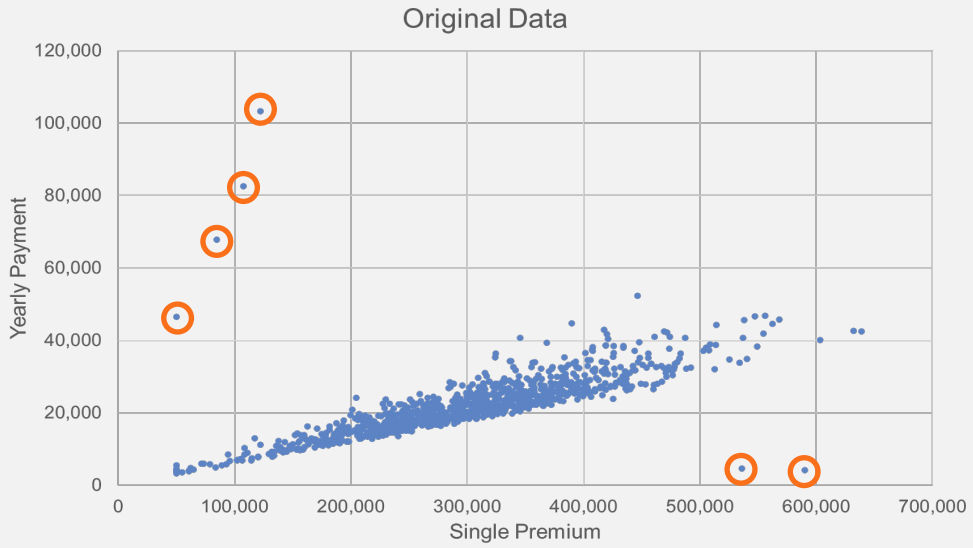
Single Premium= $122,400

Mode=12 • Modal Benefit= $8,604 = $103,248



Outliers affect SPIA PV of Benefits

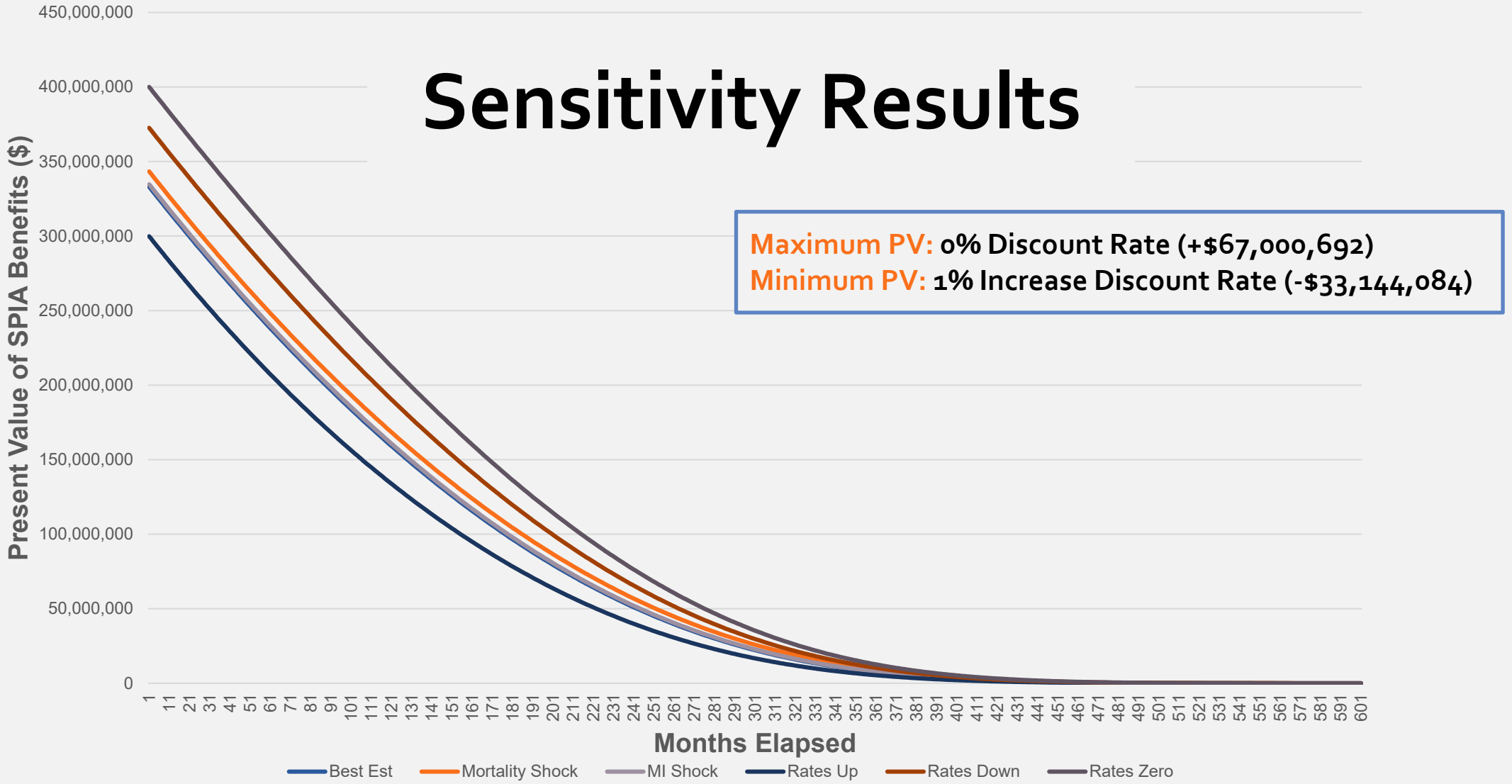
- Revised numbers where possible to infer



Sensitivity Expectations

Scenario	Expectation on PV Benefits
Best Estimate	*N/A (Base line)*
Base Mortality Shock	Present Value ↑
Mortality Improvement Shock	Present Value ↑
1% Interest Rate Increase	Present Value ↓
1% Interest Rate Decrease	Present Value ↑
Discount Rate: 0%	Present Value ↑

Sensitivity Results



Maximum PV: 0% Discount Rate (+$67,000,692)
Minimum PV: 1% Increase Discount Rate (-$33,144,084)

Scenario	Best Est	Mort Shock	MI Shock	Rates Up	Rates Down	Rates 0%
12/31/2020	$333,748,917	$344,104,431	$335,459,402	$300,541,726	$373,365,795	$400,874,084

Methodology & Implications

Accounting for Convexity

- Duration assumes interest rates and bonds have linear relationship
- Convexity allows for other factors and accounts for non-linearity changes
- Assuming yield is equal to coupon rate

$$Convexity = \frac{P_i + P_d - P_0}{2 \cdot P_0 \cdot (\Delta Y)^2}$$

$$Change\ in\ Bond\ Price = -D \cdot \Delta Y \cdot \frac{(\Delta Y)^2}{2} \cdot Convexity$$

$P_0 = bond\ price$

$P_i = bond\ price\ after\ increase\ in\ interest\ rate$

$P_d = bond\ price\ after\ decrease\ in\ interest\ rate$

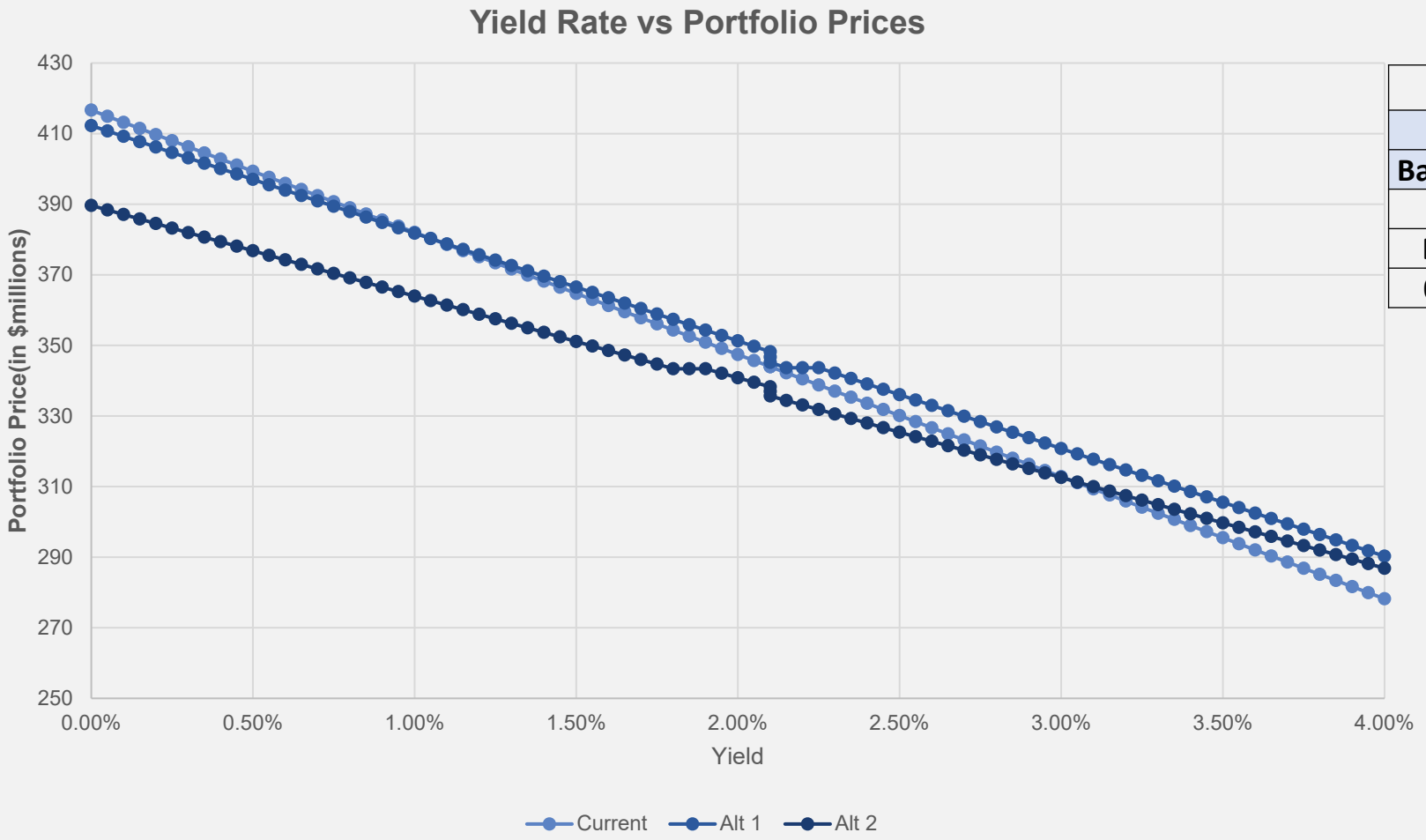
$\Delta Y = change\ in\ interest\ rate$

$D = duration$

Implications for a decreasing interest rate environment

- Bond prices increase as yield decrease, thus portfolio value increases
- Gains not realized unless portfolio was sold. Benefits of selling would be offset by lower yields
- Proceeds reinvested at potential lower interest rate results in reinvestment risk

0% Shock on Bond Portfolios



Value of Portfolio			
Portfolio	Current	Alt 1	Alt 2
Base Interest	2.10%	2.25%	1.80%
Up 1%	$309M	$313M	$318M
Down 1%	$379M	$374M	$369M
0% shock	$417M	$412M	$390M

Sensitivity Factors affecting Portfolio PV

- Exact Cash Flows & Individual Yields
- Default risk
- Embedded Options
  - Callable
  - Convertible
- Inflation Risk
- Market Interest Rates

Appropriateness of Portfolios

Current Portfolio

21% 5-year AA, 38% 10-year A, and 41% 20-year A

Pro: Hedging potential risks; Value increases when interest rate decreases

Con: Most sensitive; Inability to cover liabilities when rate increases

Alternative 1

30% 5-year A, 50% 10-year BBB, and 20% 20-year BBB

Pro: Less sensitive; A balance between current and Alt 2

Con: Inability to cover liabilities when rate increases.

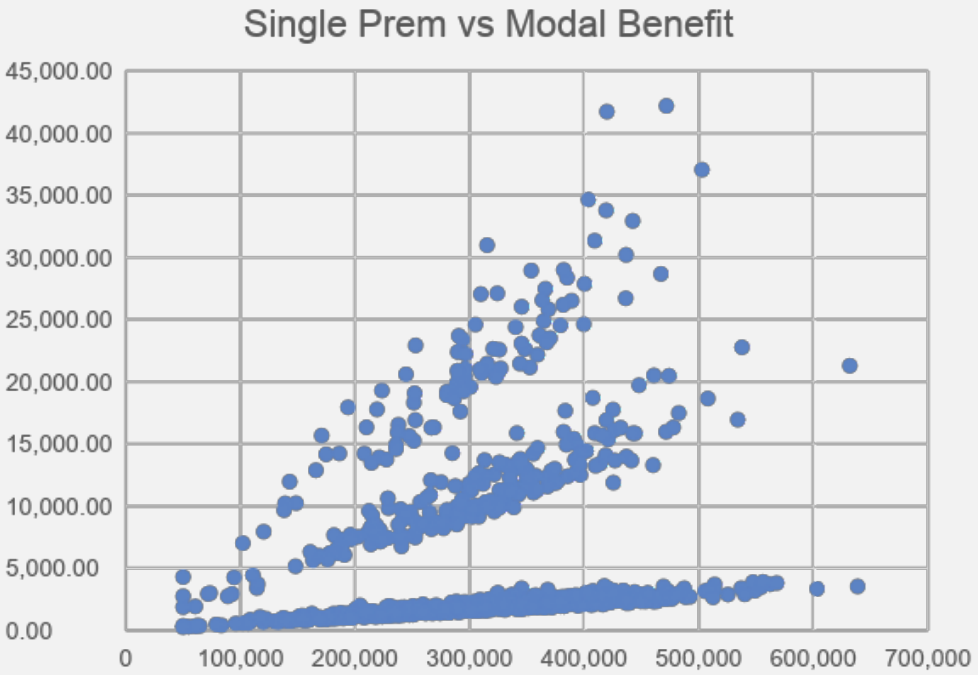
Alternative 2

50% 5-year AA, 40% 10-year A, and 10% 20-year A

Pro: Least sensitive; Covers more liability when interest rates go up(relative to other portfolios)

Con: Adverse to low interest rate environment

Data Appendix



Conclusion

Thank you judges and organizers for this great opportunity!