Session 058 PD - Validation of Asset Models

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2017 SOA Annual Meeting

Session 58: Validation of Asset Models

Daniel Finn, FCAS

October 16, 2017

Validating Asset Models

- Asset Models are a Key Component of Many Actuarial Modelling Activities
  - Cash Flow Testing
  - Economic Capital
  - MCEV
  - Strategic Asset Allocation
- Despite that, Actuaries haven’t historically spent a lot of time on Validating them
- But, the times they are a changing…

Footnote/Sources or Citations

Possible Approaches

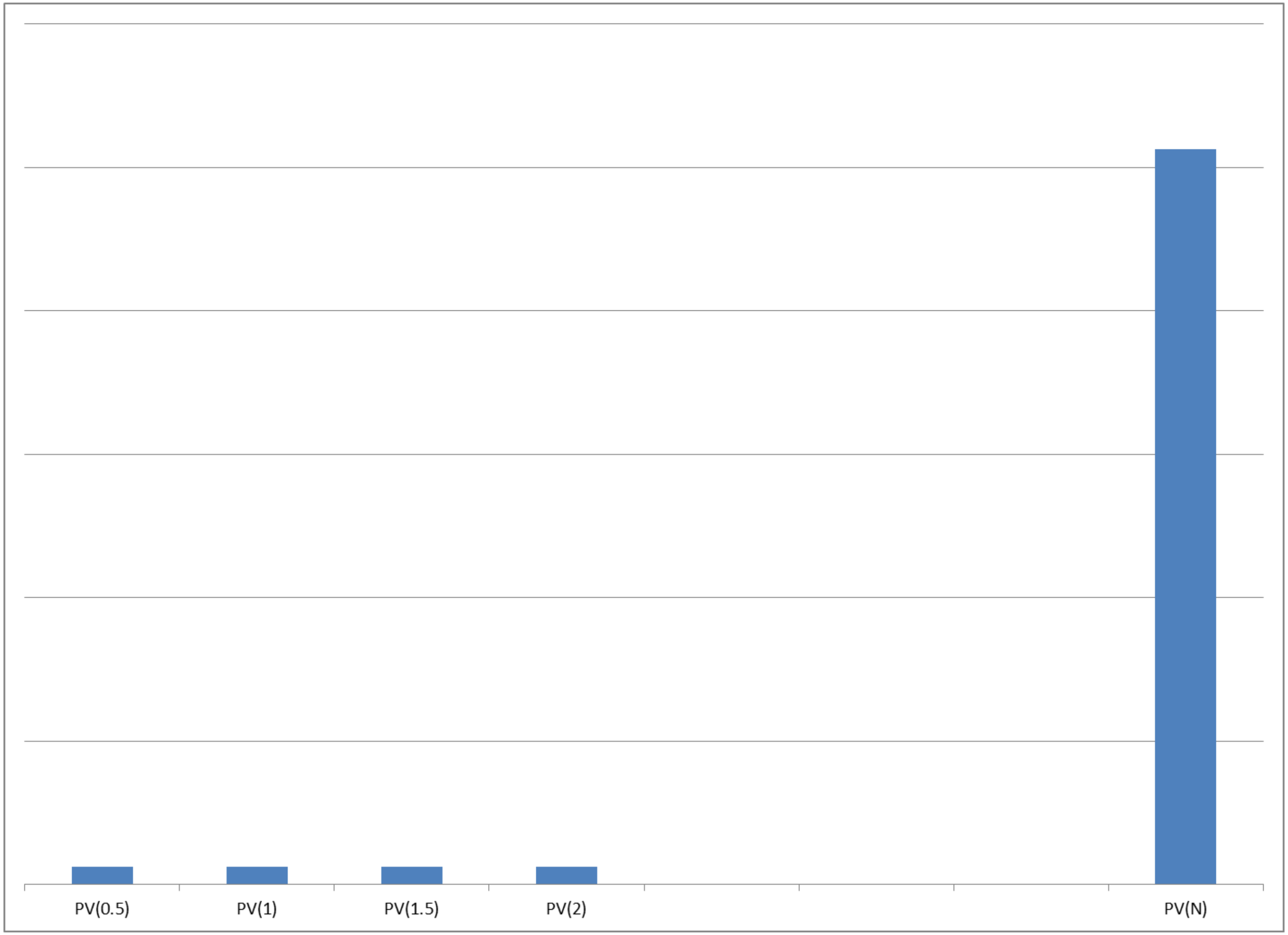
- Trust your vendor
- Duplicate key calculations
  – SIFI
- Test key characteristics

Footnote/Sources or Citations

Duplicate Key Calculations

- Consider a corporate bond
  - Periodic coupon payments
  - Principal repayment at maturity
- What do we need to price this bond?

Duplicate Key Calculations



Duplicate Key Calculations

- Treasury curve
- Corporate spread curves
- Idiosyncratic spread
  - OAS
  - Sector
  - Issuer-specific
- Rating transition
  - Single rating
  - Vector rating
- Default Dynamics
  - Probability
  - Recovery Mechanics

Duplicate Key Calculations

Simplify as much as possible

- Use a zero-coupon bond
  - Only one cash flow to value
  - All other fixed bonds are combinations
- Make sure the simple stuff works first
  - Treasuries before corporates
- Smallest period possible
- Make sure you’re testing what you’re actually using

Duplicate Key Calculations

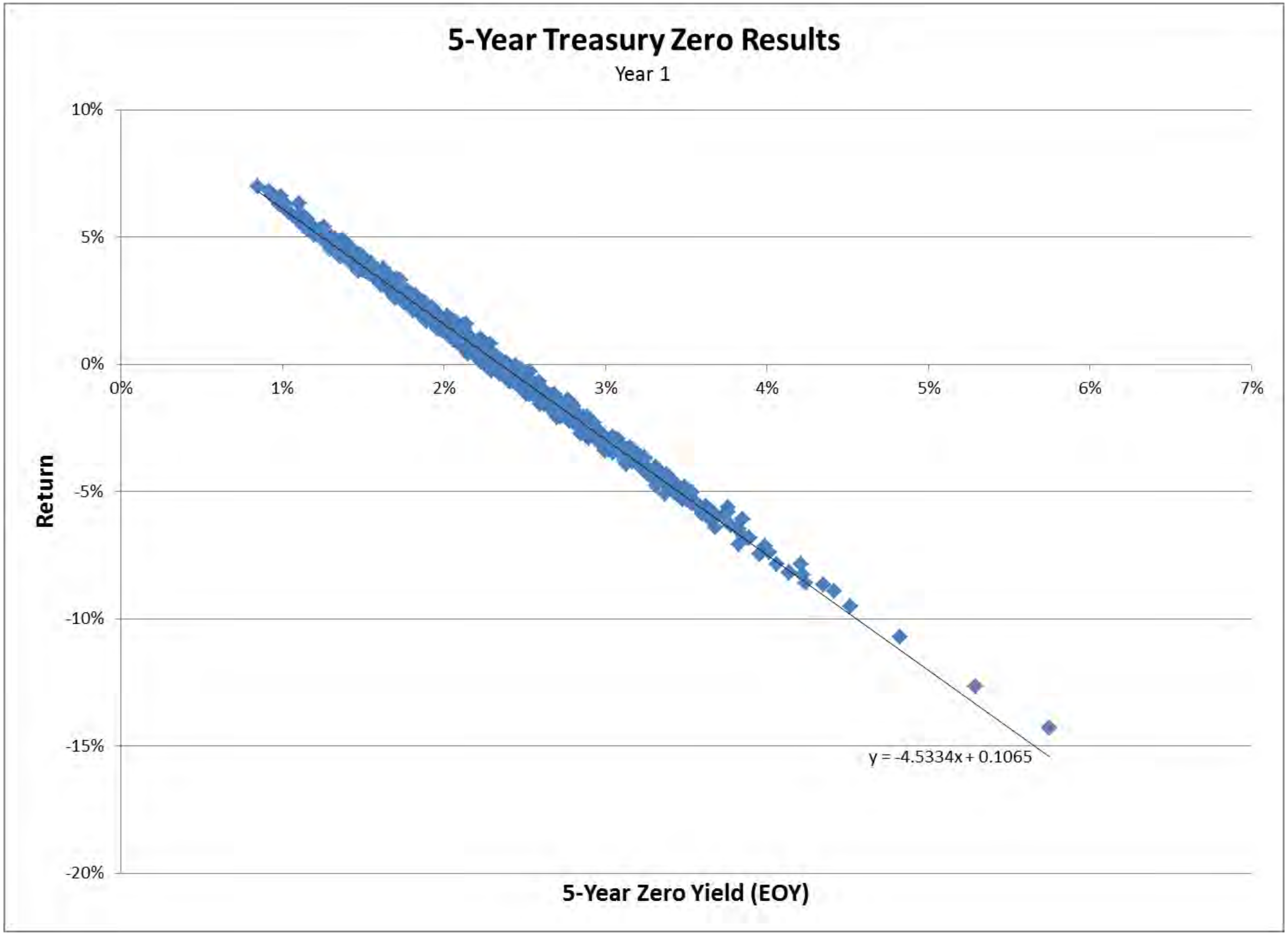
Economic Scenario Generator → Liability Calculation Engine

- Some parts of the process are obvious
  - ESG Calculates Treasury Yields
  - Liability Engine Calculates Realized Gains and Losses
- Who’s Pricing the Bonds?
- Are the Two Systems speaking the Same Language?
  - Consider Yields
  - Spot or Coupon?
  - Annual, Semi-Annual or Continuous Compounding?

Test Key Characteristics

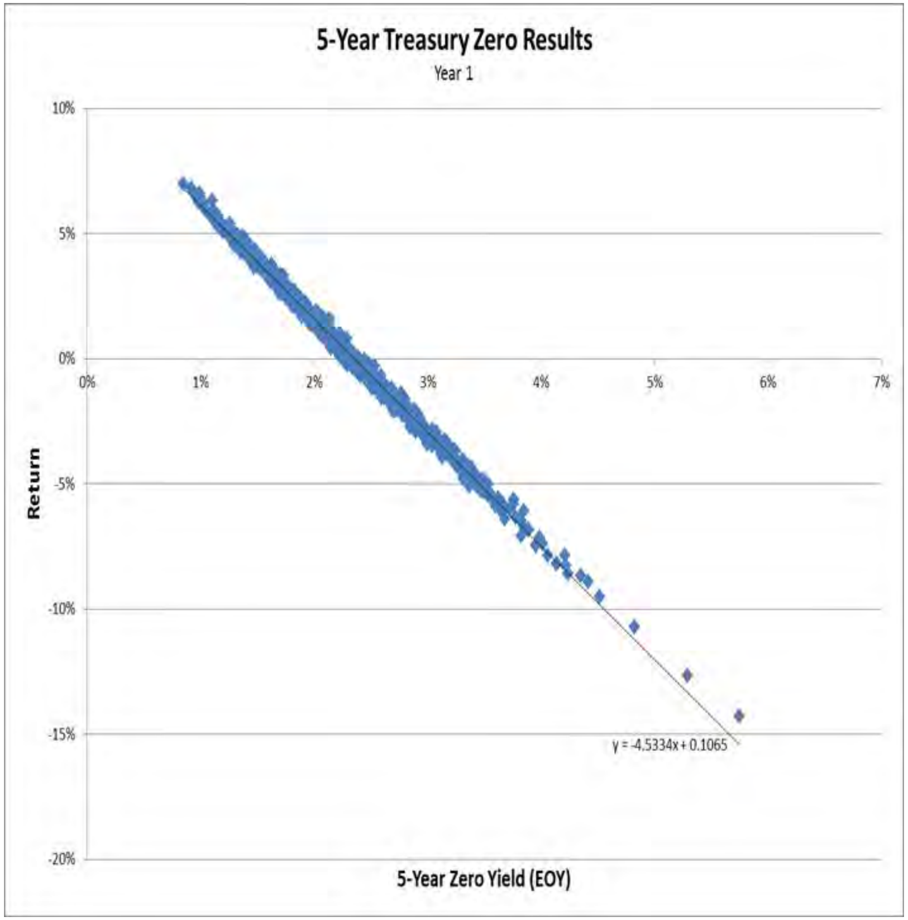
- Bond returns and yields are negatively correlated
- Longer bonds have a steeper relationship
- Bond returns tend to move together

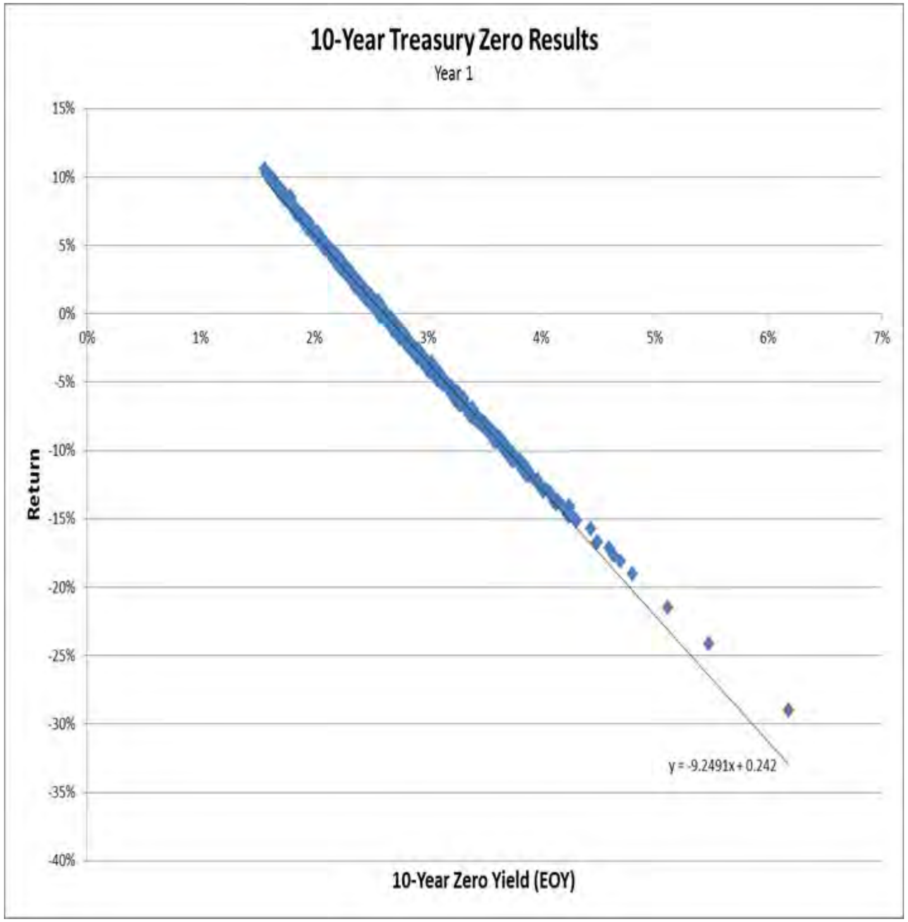
Test Key Characteristics



Prepared by Conning, Inc. Source: GEMS® Economic Scenario Generator scenario.

Test Key Characteristics





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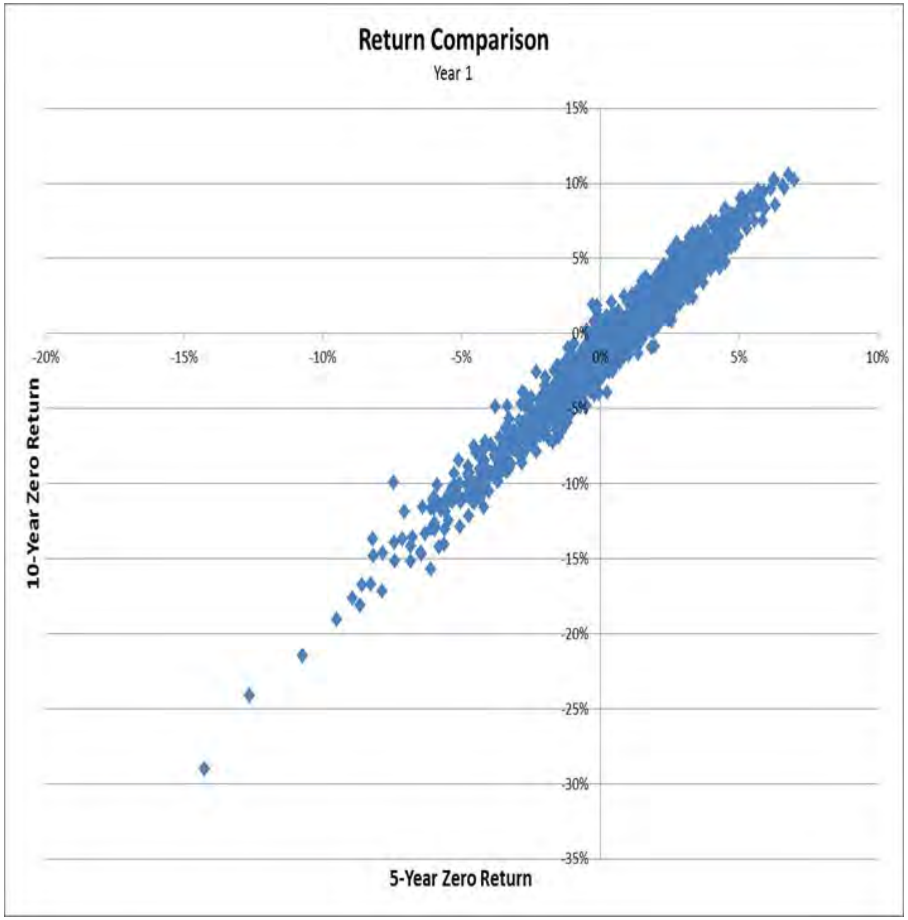
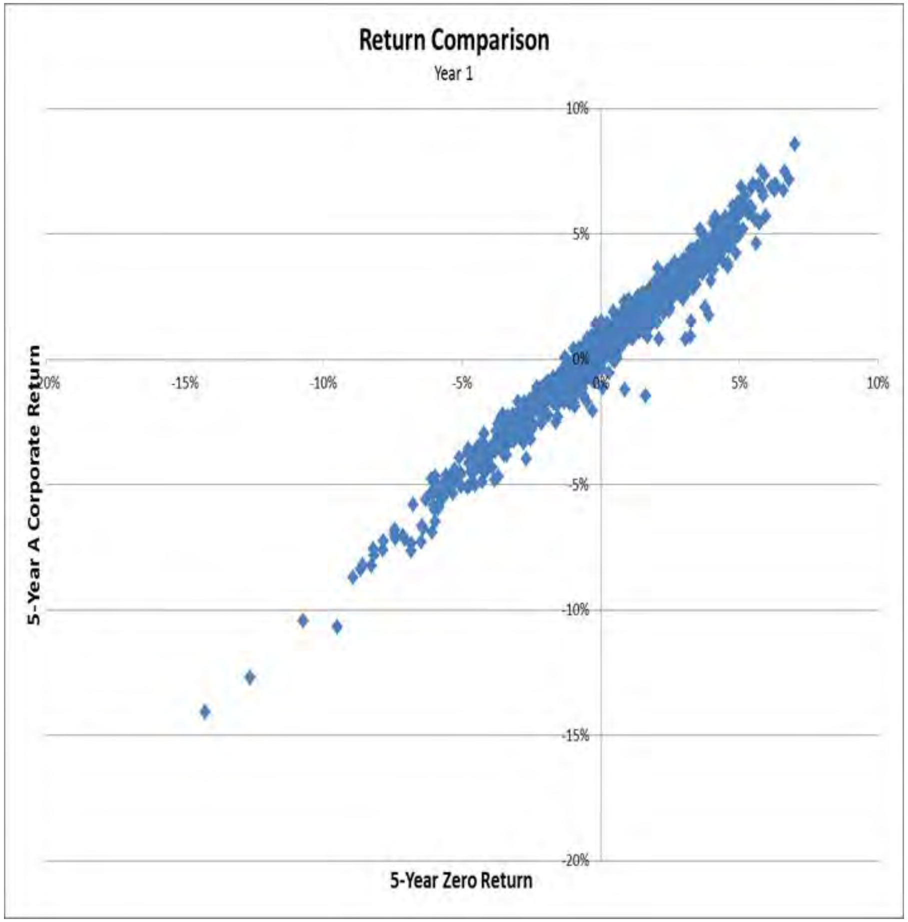
Test Key Characteristics





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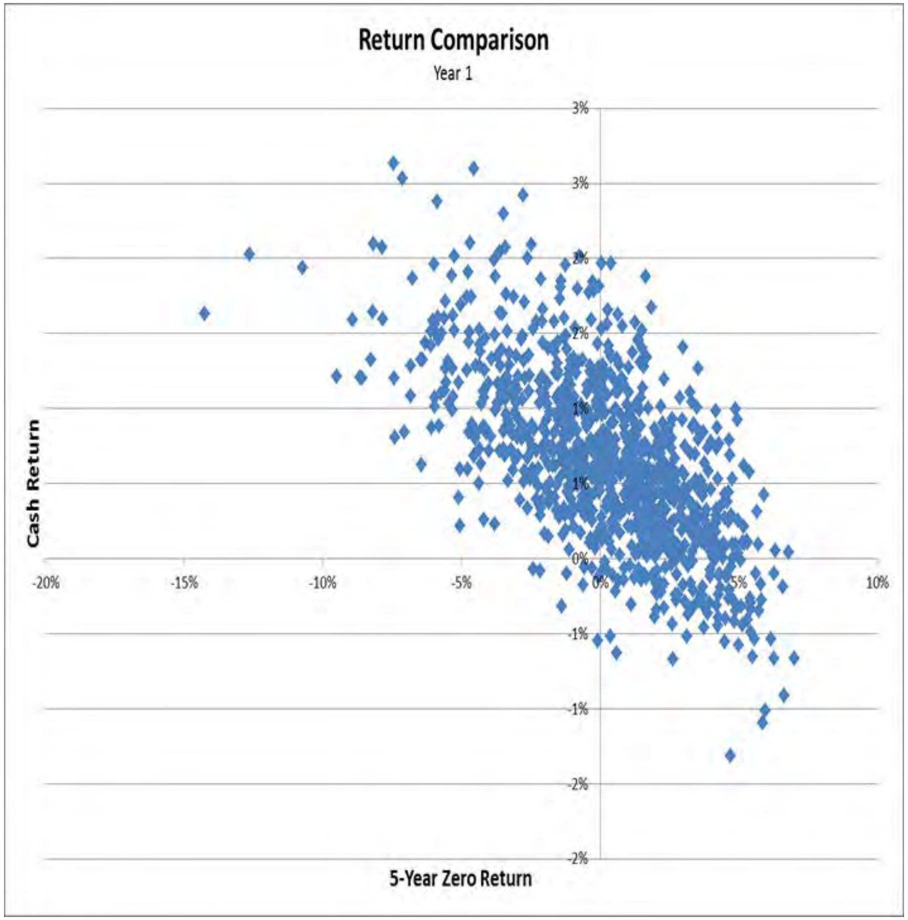
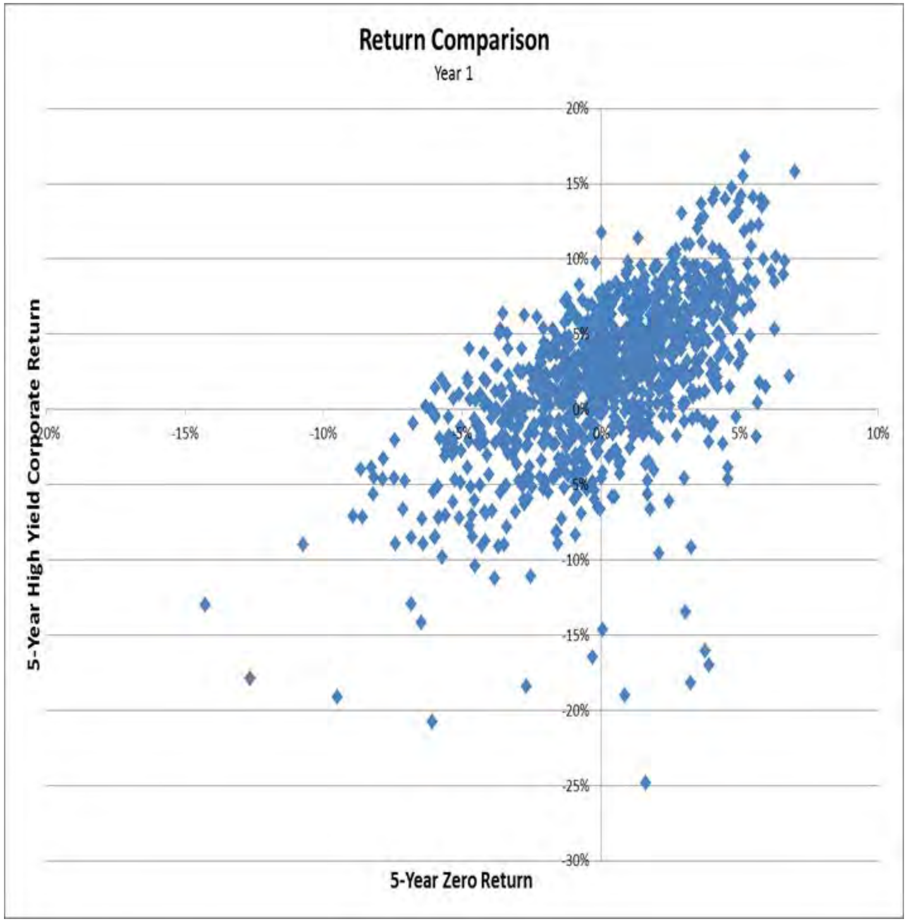
Test Key Characteristics





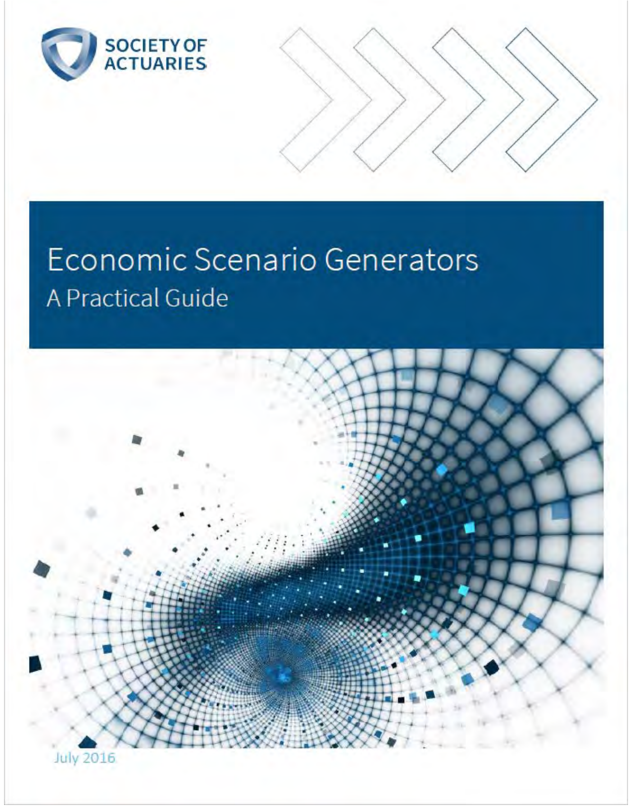
Prepared by Conning, Inc. Source: GEMS® Economic Scenario Generator scenario.

Test Key Characteristics

- Is the model calibrated for my needs?
  - What is my application?
  - What risks am I worried about?

Further Information

- SOA Published an in-depth primer on Economic Scenario Generators
  - Chapter 8: Model Validation goes even deeper into this topic
  - https://www.soa.org/research-reports/2016/2016-economic-scenario-generators/



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2017 SOA Annual Meeting - DRAFT

SESSION 58: VALIDATION OF ASSET MODELS

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Principal at the Actuarial Practice of Oliver Wyman

October 16, 2017

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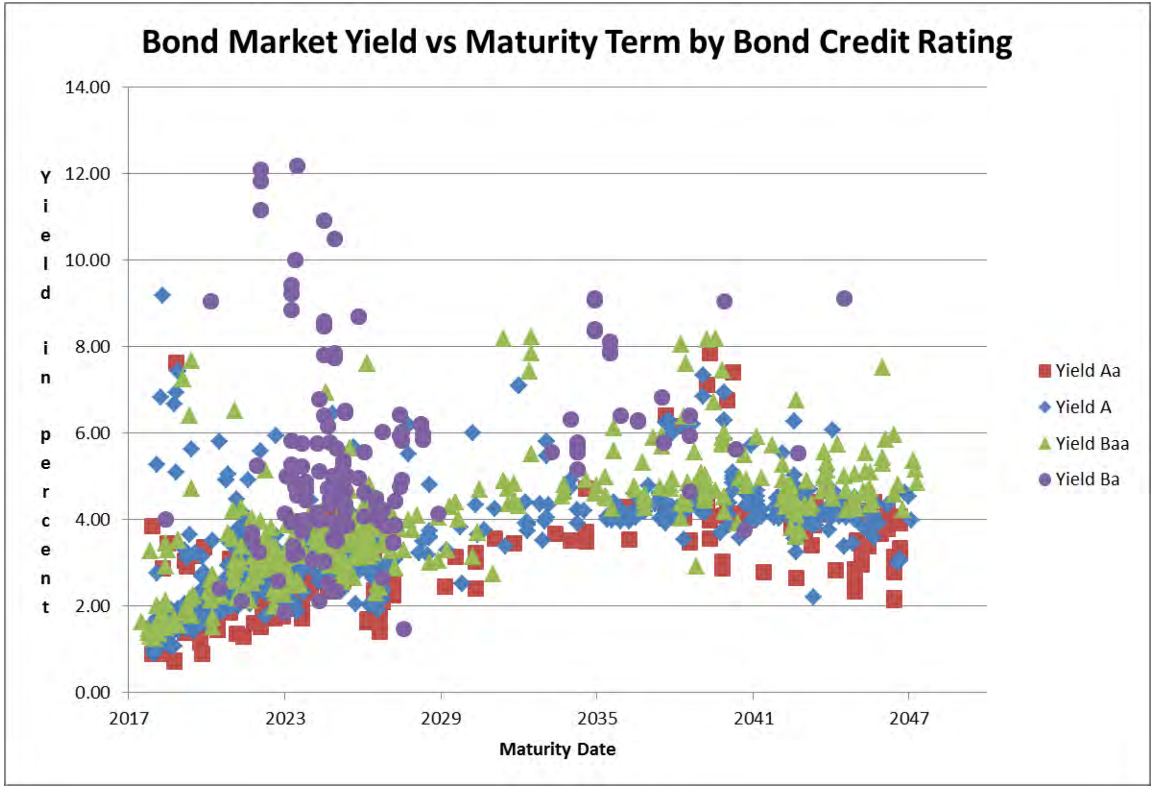
Topics

- Validation of asset cash flows, market values, statement values (including case study)
- Capturing asset and liability interaction

Validation of asset cash flows and values

- Review of book/market yields
- Review of individual assets
- Cash flow review/replication
- Portfolio and asset rollforward
- Accounting treatment

Validation of asset cash flows and values-corporate bond case study



Validation of asset cash flows and values-corporate bond case study

Book value	$750,000
Market value	$750,000
Par value	$1,000,000
Coupon (semiannual)	2.50%
Defaults (annual)	0.25%
Statement date	September 30, 2017
Maturity date	March 31, 2022

Validation of asset cash flows and values-corporate bond case study

Date	Cash Flow
3/31/2018	$12,484
9/30/2018	$12,469
3/31/2019	$12,453
9/30/2019	$12,438
3/31/2020	$12,422
9/30/2020	$12,406
3/31/2021	$12,391
9/30/2021	$12,375
3/31/2022	$1,001,159

Book and market yields = 9.40%

Validation of cash flows – reflecting credit risk

- Bonds:
  - Default risk and credit risk
  - Downgrades more common than defaults
- Impact on mortgages and other asset classes

Validation of cash flows – reflecting credit risk

- Numerical example

Validation of cash flows – prepayments, prepayment risk, liquidity risk

- Restriction of sales in software
- Modeling and output review required to avoid leverage of portfolios

Asset liability interaction

1	**Interest rate crediting**
2	**Dynamic lapses**
3	**Dividends**
4	**Disinvestment**
5	**Reinvestment**

Credited Interest

- Earned rate
- Spread
- Credit rate
- Credited rate floors

Dynamic lapses

- New money / portfolio bases
- Exponential and other formulas
- Boundary testing

Disinvestment / reinvestment

- Limits / restrictions
- Borrowing
- Liquidity
- Asset and assumption testing

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2017 SOA Annual Meeting & Exhibit

THOMAS REEDY, AVP & ACTUARY

John Hancock Financial Services

SOA Annual Meeting Session 58, Validation of Asset Models

October 16, 2017

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Agenda

- Review of Common Assumptions for Modeling Assets
- Common Modeling Issues and Their Prevention
- Validation Techniques
- Validation of Interaction of Assets & Related Balance Sheet Items
- Mechanical Focus and Practical Focus

Key Considerations When Modeling Assets

1. Asset Types and Characteristics
2. Economic Scenarios
3. Common Assumptions for Modeling Assets

Common Assumptions for Modeling Assets

1. Asset Types and Characteristics

Asset Types (not exhaustive)	Comments
Fixed Income Assets	• Actual indicative information (coupon rate, maturity date, sinking fund schedules etc.) used to model cash flows
Mortgages	• Capture the prepayment behavior • Mortgages with make whole provisions
Callable Bonds	• An approach is to call when the calculated ratio of future cash flows to the current strike price exceeds 1 • Reflect refinancing costs • Choice of a prepayment model
Derivatives	• Actual derivative characteristics used to model cash flows • Need to decide on the appropriate pricing model for the derivative.
Equities	• Income and Growth Assumptions • Scenarios that focus on the volatility of these investments • Equity modeling approaches described in AG43 a useful source of guidance

Key Considerations When Modeling Assets

2. Economic Scenarios

- Assumptions
  - Interest Rates
  - Fund Returns
  - Integrated Scenarios
- Framework
  - Deterministic
  - Stochastic: Real-world or Risk-neutral?

Key Considerations When Modeling Assets

3. Common Assumptions for Modeling Assets

Type	Comments
Yields	• Typically start with the yield curve at valuation date
Spreads	• Typically start with the spreads at valuation date → common approach is to grade to historical spreads at the end of n years • Vary by asset quality and term • Is it appropriate to set consistent with the default assumption?
Defaults	• Company experience vs. Industry studies • Consistency with current market values for similar investments (kind & quality) • Grading to long term expectations • Future rating migrations

Key Considerations When Modeling Assets

3. Common Assumptions for Modeling Assets (cont.)

Type	Comments
Investment Expenses	• Actual to expected experience is important
Reinvestment	• Constructing a reinvestment portfolio • Consistency with company practice (e.g. ALM)
Disinvestment	• Consistency with company practice • Small shortfalls vs. large shortfalls
Interest on Interim Net Cash Flows	• Positive (or negative) net cash flows between reinvestment dates • Consistency with the interest rate scenario
Model Borrowing Rate	• One approach is to equate to the foregone interest on surplus • **Important:** Look at extent of borrowing that occurs in the Model

Common Modeling Issues and Their Prevention

- Issue: The asset model is not well understood or there is uncertainty about where to spend the time appropriately
- Prevention: Spend time understanding the model, particularly:
    - makeup of the asset portfolio
    - how the cashflows emerge
    - what is driving investment and disinvestment in the model?

Common Modeling Issues and Their Prevention

- Issue: The asset portfolio becomes unrepresentative.
- Prevention: Review the reinvestment assumption and scaling of assets.
  - If the reinvestment assumption has a constant mix of short and long assets, the portfolio mix may become unrepresentative in the projection.
    - Look at your projected balance sheets at various future time points to see if this is happening.
    - If it is, consider something more sophisticated like duration matching.
  - Additionally, this can occur at the outset of your projection if the assets have to be scaled for a particular application.

Common Modeling Issues and Their Prevention (cont.)

- Issue: Distortions are occurring due to the level of borrowing. Additionally, arbitrage may have been introduced into the Model.
- Prevention: As discussed previously, look at the projected results to see if this is happening.
  - Determine whether the reinvestment and disinvestment strategies have been appropriately modeled.
  - Check the margins/spreads etc. so that there is not unintended arbitrage.

Common Modeling Issues and Their Prevention (cont.)

- **Issue:** For public bonds, a modeling approach is to calibrate model MVs to actual MVs by solving for a spread. There can be outliers and unreasonable results for individual assets.

Actual MV = Model CFs disc. at (Treasury + Assumed Spread + Solved for Spread)

- **Prevention:** Get familiar with the components of the portfolio
  - Check the categorization of the asset to determine if it has been misclassified and/or a data error exists.
  - Check for consistency with your default assumptions.
  - Solved for spreads need to be reviewed for reasonability/consistency and not just an automatic modeling procedure.

Validation Techniques

- Static vs. Dynamic Validations
  - Static: Checking Model opening balances against actual balances
  - Dynamic: Comparing current/prior Model projections against actual results
- Assumption Validation
  - Are the assumptions appropriate for the Model?
    - Use of margins or not
  - Is the Model capturing these assumptions appropriately?
    - Are any modeling simplifications acceptable?
    - Are certain assumptions having an undue influence?
  - Making Use of Experience & Calibration
    - e.g. use of knowledge gained from realized spreads on sales

Validation Techniques

- Projecting out Financial Statements
  - Balance Sheets
    - Economic Balance Sheets vs. Statutory Balance Sheets
  - Income Statements
    - Linking the Balance Sheets
    - Insights into what are driving the cash demands
  - Cash Flow Statements
    - Useful in analyzing the levels of investment, disinvestment and consequential levels of borrowing

Validation of Interaction of Assets and Related Balance Sheet Items

- How is the Balance Sheet emerging both short term and long term
- An economic balance sheet versus a statutory balance sheet perspective (e.g. real estate)
- What is driving the disinvestment and investment in the balance sheet? i.e. have you analyzed the underlying cash flows that are driving disinvestment and investment?
- Is the level of borrowing appropriate and realistic?

Mechanical Focus and Practical Focus

- The Purpose of the Asset Model
- Control framework
- Rules and requirements by regulators
- Audit Requirements
- Peer Review
- Documentation
- Outside Vendor Software or Homegrown Systems
  - Checking the parameters set by the vendor

Mechanical Focus and Practical Focus (cont.)

- Inherited Models vs. Newly Developed Models
  - With inherited models, you still need to get comfortable that the results are correct and that they make sense to you.
  - With newly developed models, you need to be satisfied that sufficient testing has been performed.
- Talk to Others
  - Investments
  - ALM
  - Hedging
  - Other Valuation areas
- Finally, where applicable, ensure that Standards of Practice have been met.

References

1. Asset Adequacy Analysis

   August 2014 Exposure Draft

   American Academy of Actuaries

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