



29 - ALM - Considerations and Tradeoffs in Approaches to Asset Modeling

[SOA Antitrust Disclaimer](#)

[SOA Presentation Disclaimer](#)

2019 Valuation Actuary Symposium

SESSION 29: CONSIDERATIONS AND TRADEOFFS IN APPROACHES TO ALM MODELING

PATRICK LEDLEE, FSA

Principal at LW Consulting Group

August 26, 2019



SOCIETY OF ACTUARIES

Antitrust Notice for Meetings

Active participation in the Society of Actuaries is an important aspect of membership. However, any Society activity that arguably could be perceived as a restraint of trade exposes the SOA and its members to antitrust risk. Accordingly, meeting participants should refrain from any discussion which may provide the basis for an inference that they agreed to take any action relating to prices, services, production, allocation of markets or any other matter having a market effect. These discussions should be avoided both at official SOA meetings and informal gatherings and activities. In addition, meeting participants should be sensitive to other matters that may raise particular antitrust concern: membership restrictions, codes of ethics or other forms of self-regulation, product standardization or certification. The following are guidelines that should be followed at all SOA meetings, informal gatherings and activities:

- **DON'T** discuss your own, your firm's, or others' prices or fees for service, or anything that might affect prices or fees, such as costs, discounts, terms of sale, or profit margins.
- **DON'T** stay at a meeting where any such price talk occurs.
- **DON'T** make public announcements or statements about your own or your firm's prices or fees, or those of competitors, at any SOA meeting or activity.
- **DON'T** talk about what other entities or their members or employees plan to do in particular geographic or product markets or with particular customers.
- **DON'T** speak or act on behalf of the SOA or any of its committees unless specifically authorized to do so.
- **DO** alert SOA staff or legal counsel about any concerns regarding proposed statements to be made by the association on behalf of a committee or section.
- **DO** consult with your own legal counsel or the SOA before raising any matter or making any statement that you think may involve competitively sensitive information.
- **DO** be alert to improper activities, and don't participate if you think something is improper.

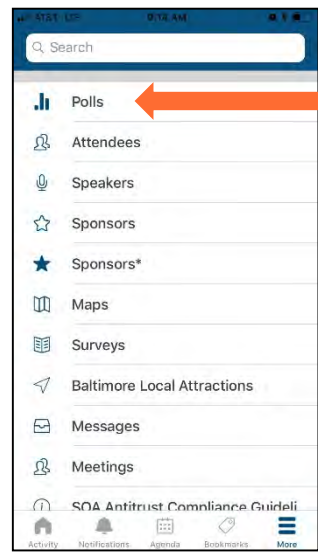
If you have specific questions, seek guidance from your own legal counsel or from the SOA's Executive Director or legal counsel.

Presentation Disclaimer

Presentations are intended for educational purposes only and do not replace independent professional judgment. Statements of fact and opinions expressed are those of the participants individually and, unless expressly stated to the contrary, are not the opinion or position of the Society of Actuaries, its cosponsors or its committees. The Society of Actuaries does not endorse or approve, and assumes no responsibility for, the content, accuracy or completeness of the information presented. Attendees should note that the sessions are audio-recorded and may be published in various media, including print, audio and video formats without further notice.

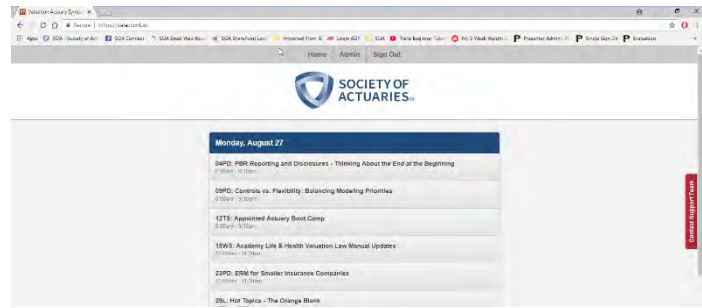
To Participate, look for Polls in the SOA Event App or visit valact.cnf.io in your browser

Find The Polls Feature Under **More** In The Event App



or

Type valact.cnf.io In Your Browser



Choose your session



Respond to Polls when they appear

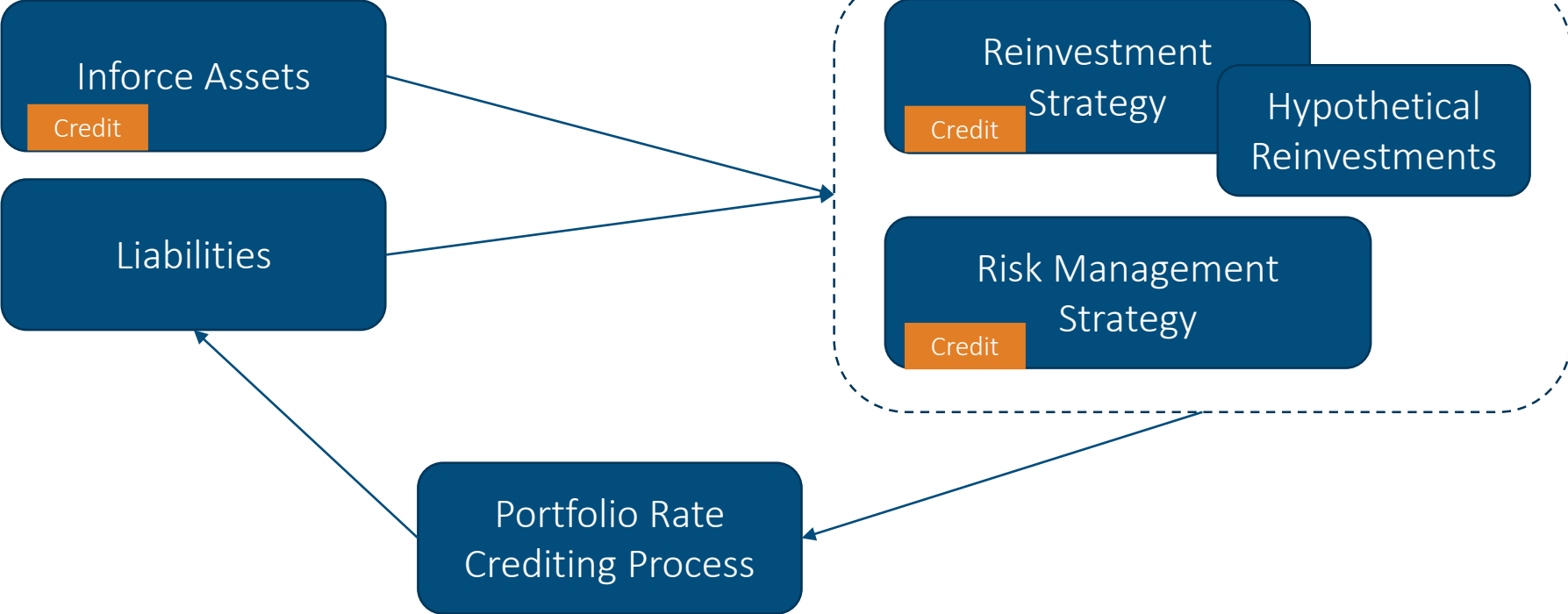
“All models are wrong, some are useful”

-George E.P. Box

ALM Modeling Use Cases

- Regulatory Compliance (AAT/ORSA)
- Reserves (AG43/PBR/CALM)
- Risk Management (Internal Stress Testing)
- Capital Planning (C3P1/Economic)
- Forecasting/Budget Projections

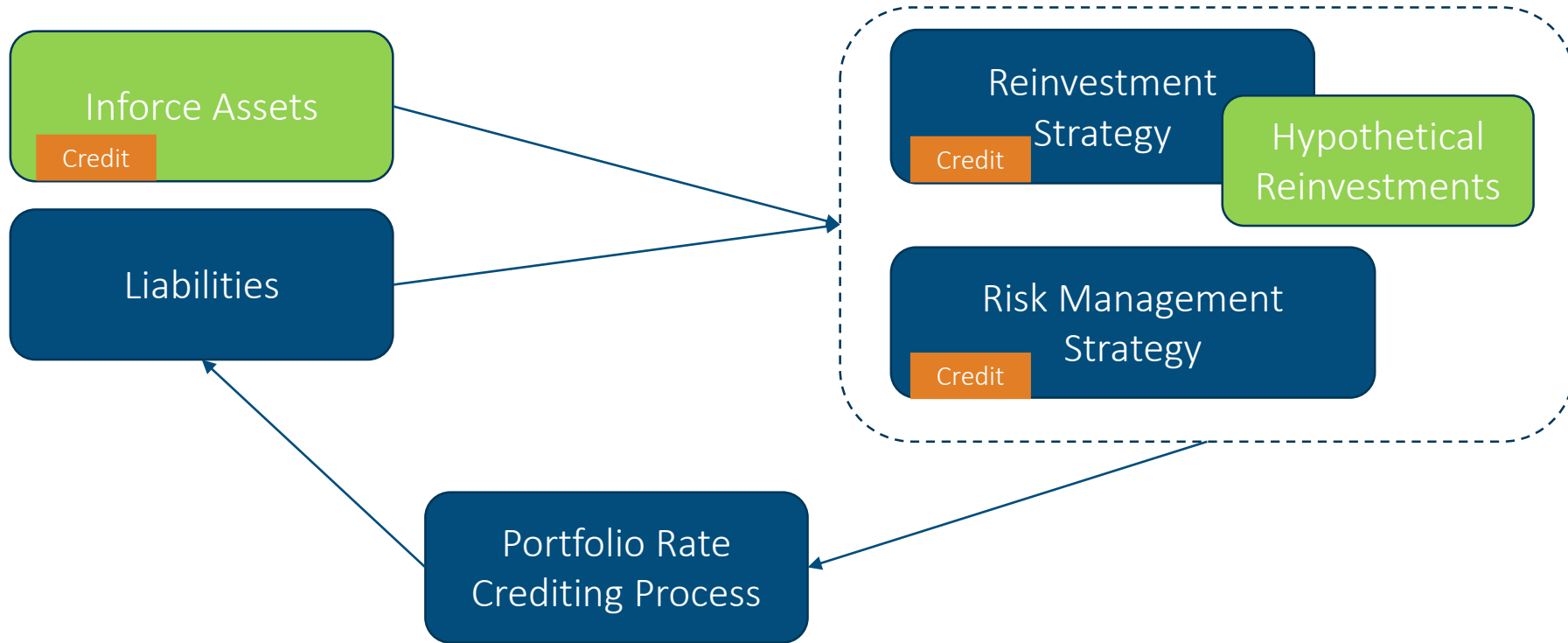
ALM Modeling Components



Asset Performance Impact on Model Results

- Investment Income directly impacts projected Profit and Accumulated Surplus
- $Inv\ Inc_t = Asset\ Cashflows_t + \Delta(Statement\ Value)$
- Investment Income Components
 - Earned Income
 - Expected changes amortized cost basis
 - Investment Expenses
 - Default Losses
 - Change in unrealized gain/loss
 - Gains/Losses from sales

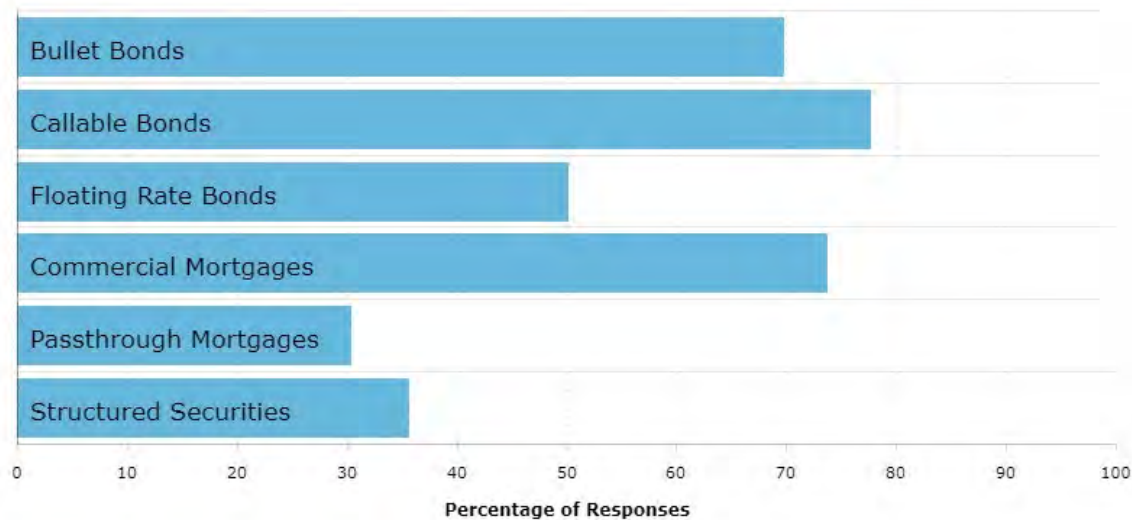
Inforce Asset Projection Components



Asset Projection Components

- Cash Flows
 - Coupons/Maturities → Liability Product Features
 - Defaults → Mortality
 - Investment Expenses
 - Prepayments → Dynamic behavior (lapses)
- Book Values → Reserves based on static discount factor
 - IRR's
- Market Values → Embedded Value Reserve
 - Discounting Spreads
 - Optionality

Poll: What asset types are projected natively in your ALM models?



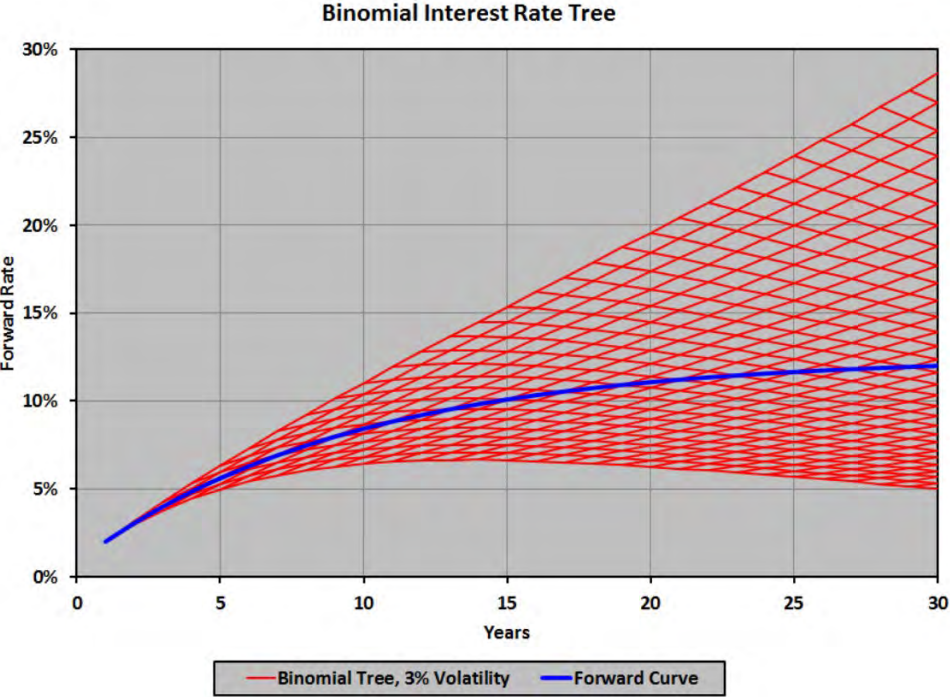
Valuing Assets with Embedded Optionality

- Deterministic “implied forward” path
 - Single cashflow projection discounted at market curve

VS

- Simulation Approach
 - Embedded option valuation using interest rate trees
 - Average PV of cashflow projections along stochastic scenarios

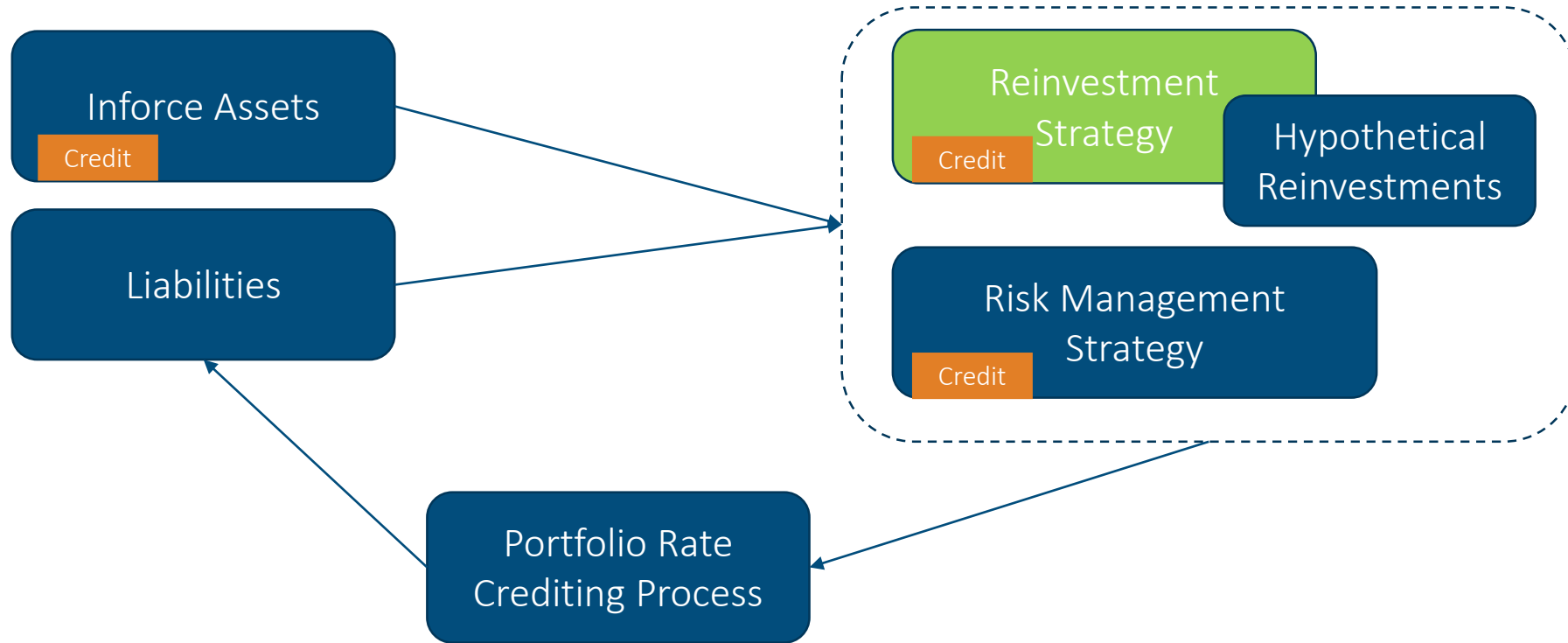
Call Option Valuation: Simulation vs. Deterministic



Implementation Considerations

- Model results impact
- Runtime feasibility
- Alignment with model purpose

Reinvestment Strategy Components



Reinvestment Strategy Components

- Positive Investment Parameters
 - Allocations/Guidelines
 - Tactical Strategies
- Disinvestment Parameters
 - Tactical vs. Strategic Selling
 - Sales Costs
 - Borrowing Strategy

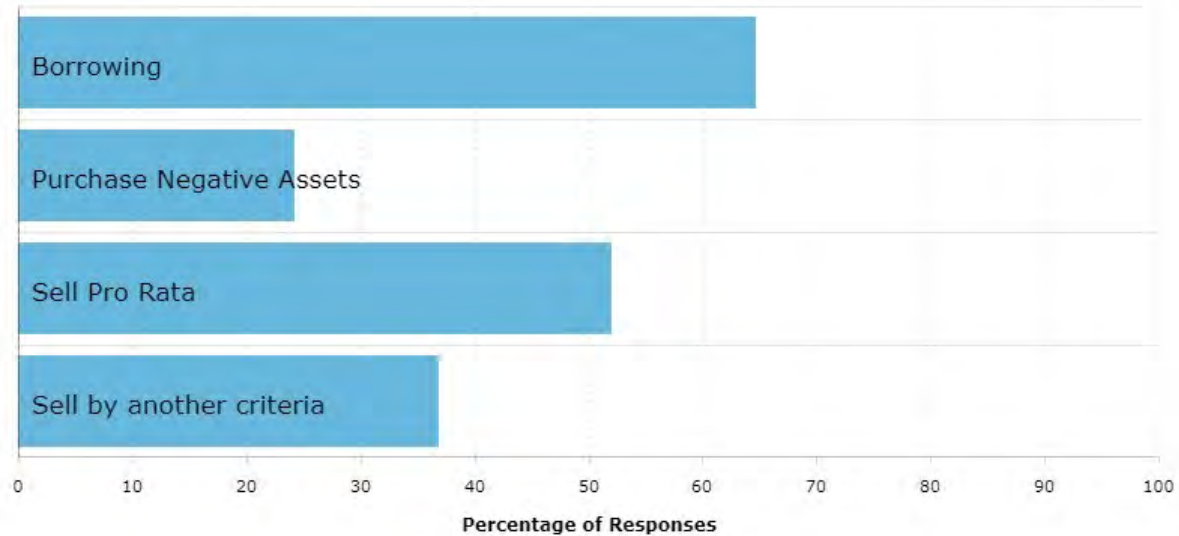
Positive Investment Methodologies

- Fixed 50%/50% allocation between AA/A corporate bonds

vs

- Adjusting investment profile for specific economic conditions
- Reflecting cash accumulations for upcoming known deficiencies

Poll: What disinvestment strategies are employed in your ALM models?



Disinvestment Methodologies

- Borrow at YC + Spread
- Pro-Rata Sales/Purchase Negative Assets

VS

- Tiered sales reflecting priorities by liquidity level
- Tactical sales reflecting yield curve environment

Identifying Impactful Opportunities for Adding Sophistication

- Analyzing Extreme Scenario Results
 - Decipher the story of “what is driving results”
 - Do the drivers accurately reflect what would occur in that environment?
- Is the modeling exercise identifying a risk that you do presently mitigate or intend to mitigate in the future?

Avoiding False Precision

- More sophisticated methods will contain more assumptions
- Added precision may not impact model precision
 - Mortgage market values when assets are not sold
- Added sophistication may not perfectly reflect reality
 - Callable municipal bonds use lottery call system
 - Remember “All models are wrong, but some are useful”

Weighing the Options

- Costs
 - Time/resources to code/implement/test
 - Time/resources to run reasonable number of scenarios
 - Risk of increasing model error with extra assumptions
- Benefits
 - Projected balance sheets better reflect expected reality
 - Increased visibility of embedded risks
 - Guide to test risk mitigation strategies



**SOCIETY OF
ACTUARIES®**

2019 Valuation Actuary Symposium

CARL TRACY

NATIONWIDE INVESTMENTS

Session 29, Considerations and Tradeoffs in Approaches to Asset Modeling

August 26, 2019





Modeling Credit Risk in ALM Models

Carl Tracy

Nationwide Insurance

SOCIETY OF ACTUARIES

Antitrust Notice for Meetings

Active participation in the Society of Actuaries is an important aspect of membership. However, any Society activity that arguably could be perceived as a restraint of trade exposes the SOA and its members to antitrust risk. Accordingly, meeting participants should refrain from any discussion which may provide the basis for an inference that they agreed to take any action relating to prices, services, production, allocation of markets or any other matter having a market effect. These discussions should be avoided both at official SOA meetings and informal gatherings and activities. In addition, meeting participants should be sensitive to other matters that may raise particular antitrust concern: membership restrictions, codes of ethics or other forms of self-regulation, product standardization or certification. The following are guidelines that should be followed at all SOA meetings, informal gatherings and activities:

----- DON'T -----

- **DON'T** discuss your own, your firm's, or others' prices or fees for service, or anything that might affect prices or fees, such as costs, discounts, terms of sale, or profit margins.
- **DON'T** stay at a meeting where any such price talk occurs.
- **DON'T** make public announcements or statements about your own or your firm's prices or fees, or those of competitors, at any SOA meeting or activity.
- **DON'T** talk about what other entities or their members or employees plan to do in particular geographic or product markets or with particular customers.
- **DON'T** speak or act on behalf of the SOA or any of its committees unless specifically authorized to do so.

----- DO -----

- **DO** alert SOA staff or legal counsel about any concerns regarding proposed statements to be made by the association on behalf of a committee or section.
- **DO** consult with your own legal counsel or the SOA before raising any matter or making any statement that you think may involve competitively sensitive information.
- **DO** be alert to improper activities, and don't participate if you think something is improper.

If you have specific questions, seek guidance from your own legal counsel or from the SOA's Executive Director or legal counsel.

Presentation Disclaimer

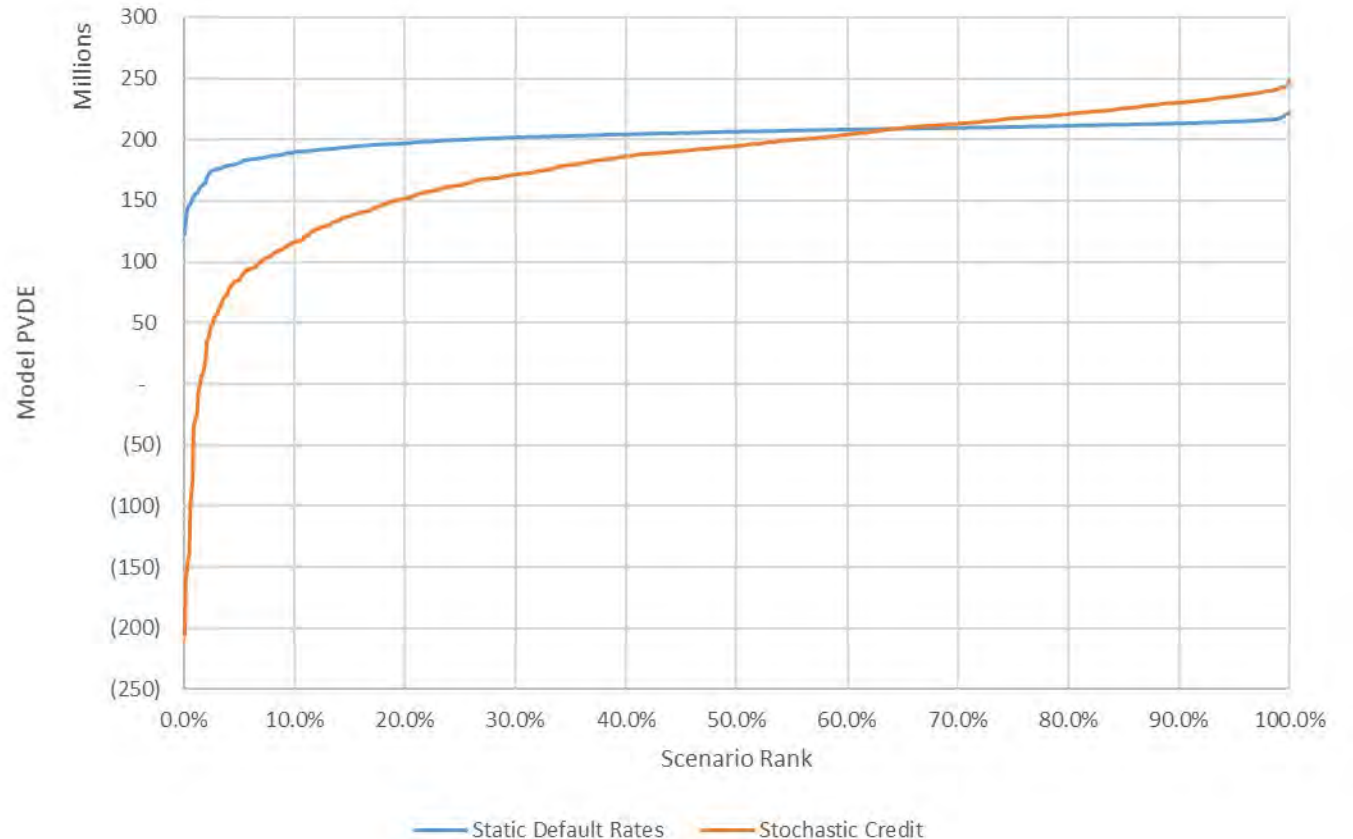
Presentations are intended for educational purposes only and do not replace independent professional judgment. Statements of fact and opinions expressed are those of the participants individually and, unless expressly stated to the contrary, are not the opinion or position of the Society of Actuaries, its co-sponsors or its committees. The Society of Actuaries does not endorse or approve, and assumes no responsibility for, the content, accuracy or completeness of the information presented. Attendees should note that the sessions are audio-recorded and may be published in various media, including print, audio and video formats without further notice.

Modeling Credit Risk

- **Many traditional ALM models ignore the correlation of default risk to the economy**
- **The correlation of defaults with equity returns could cause adverse interactions between traditional lines and variable annuities**
 - As equity values go down, the risk of credit events goes up
 - Modeling this correlation will deepen tails and give a more accurate view of tail measures such as CTE-90
- **However, modeling this correlation can be a challenge and may not be necessary for many applications**
- **We will review 3 ways to model credit risk and when they are appropriate**

Why is Modeling Credit Risk Important?

- **The correlation of defaults with equity returns could cause adverse interactions between traditional lines and variable annuities**
 - As equity values go down, the risk of credit events goes up
- **Gives us a more accurate view of tail measures such as CTE-90**



Credit Risk in ALM Models

- **Static Default**

- The most simplistic type of model. Static default and recovery rates that vary by asset class and rating.

- **Mapped Default Rates**

- Scenarios are mapped to a set of representative scenarios that are run through a quantitative credit analysis system like KMV.

- **Stochastic Credit**

- Default rates correlated to the economic scenario, with idiosyncratic risk that is specific to the issuer.

Static or Deterministic Default Rates

- **Appropriate for models where we care about averages such as cash flow testing, pricing**
- **By far the easiest to implement**
 - No credit migration
 - Defaults and recoveries vary by asset class and rating, we can add sector and term to maturity if we're feeling adventurous
 - Could use long-term average rates or grade from view of current to long-term
- **Advantages**
 - Easy to build, validate and understand
 - There is a plethora of data available
- **Disadvantages**
 - While it models *most* scenarios well it completely ignores volatility in default rates and stress due to downgrades

Mapped Defaults

- **Appropriate for applications where tail risk is important such as internal risk models and setting capital**
- **To recognize the correlation of defaults with economic scenarios without building our own model, we can leverage an external quantitative credit analysis system like KMV**
 - A representative set of economic scenarios is built and run through the external system
 - Each model scenario is mapped to a representative scenario and its default rates are used for the ALM model
- **Advantages**
 - This approach captures more of the tail risk
 - Can run specific historical scenarios (Y2K, financial crisis)
 - Simpler than stochastic Credit
- **Disadvantages**
 - Ignores concentration risk
 - Less intuitive to understand and more difficult to implement than static defaults

Full Multi-Year ALM with Stochastic Credit

- **Appropriate for applications where tail risk is important such as internal risk models and setting capital**
- **Rating transitions and defaults are linked to the economic scenario**
 - Defaults and migration are driven by two main factors:
 - Systemic – pulled directly from economic scenario (e.g. equity returns)
 - Idiosyncratic – unique to the issuer and uncorrelated
- **Advantages**
 - Capable of capturing deep tails
 - Credit migrations will allow modeling impairments and capital strain
- **Disadvantages**
 - Designing the model can be a lengthy process
 - Calibration is not trivial
 - Validation can be difficult, especially in the context of an ALM model
 - Can require significantly more scenarios

Stochastic Credit - Scenarios

- **How many economic drivers?**
 - One factor model is difficult enough to develop and calibrate
 - Each additional factor increases complexity with diminishing returns
- **Economic scenarios**
 - Behavior of drivers will be critical
 - Negative serial correlations such as those from a strong mean reverting process could mitigate credit risk
 - Does driver show patterns that are representative of past events?
 - Example: if equity returns are the driver, does your ESG replicate events similar to the Great Depression?

Stochastic Credit - Reinvestment

- **Reinvestment methodology becomes more important with credit transitions in the model**
 - Naïve reinvestment – static, predetermined strategy with no consideration of where the model currently is
 - Strict rebalancing – Always force the model hit targets. Will most likely cause severe portfolio turnover
 - Restrained rebalancing – set limits on how much of the portfolio can turn over. Requires many hard questions to be answered
- **How do you model management action?**
 - We can't model credit research and proactive portfolio adjustment
 - Does the model switch from “business as usual” to more aggressive measures when the portfolio is stressed?
 - What is the trigger?
 - How do you balance increasing credit quality vs gains/losses
 - What about insolvency?

Stochastic Credit - Reinvestment assets

- **ALM models tend to reinvest in asset cells that are much larger than a typical asset purchase**
- **Treating reinvestment asset cells as coming from a single issuer will cause problems**
 - Cells could be split into multiple asset cells
 - Could treat reinvestments as a probability distribution of well diversified assets

Final Thoughts

- **Models (unfortunately) do what you tell them to, not what you want them to do**
- **No model is going to be able to handle every situation thrown at it and it is very difficult to model management action**
 - The model results in the tail are likely going to worse than reality *for that particular economic scenario.*
- **Building, implementing and getting support/approval for a model like this will likely take several years**

2019 Valuation Actuary Symposium

SESSION 29: ALM MODELING CONSIDERATIONS

DAVID YU, FSA, MAAA

Director & Actuary at Prudential Financial

August 26, 2019



SOCIETY OF ACTUARIES

Antitrust Notice for Meetings

Active participation in the Society of Actuaries is an important aspect of membership. However, any Society activity that arguably could be perceived as a restraint of trade exposes the SOA and its members to antitrust risk. Accordingly, meeting participants should refrain from any discussion which may provide the basis for an inference that they agreed to take any action relating to prices, services, production, allocation of markets or any other matter having a market effect. These discussions should be avoided both at official SOA meetings and informal gatherings and activities. In addition, meeting participants should be sensitive to other matters that may raise particular antitrust concern: membership restrictions, codes of ethics or other forms of self-regulation, product standardization or certification. The following are guidelines that should be followed at all SOA meetings, informal gatherings and activities:

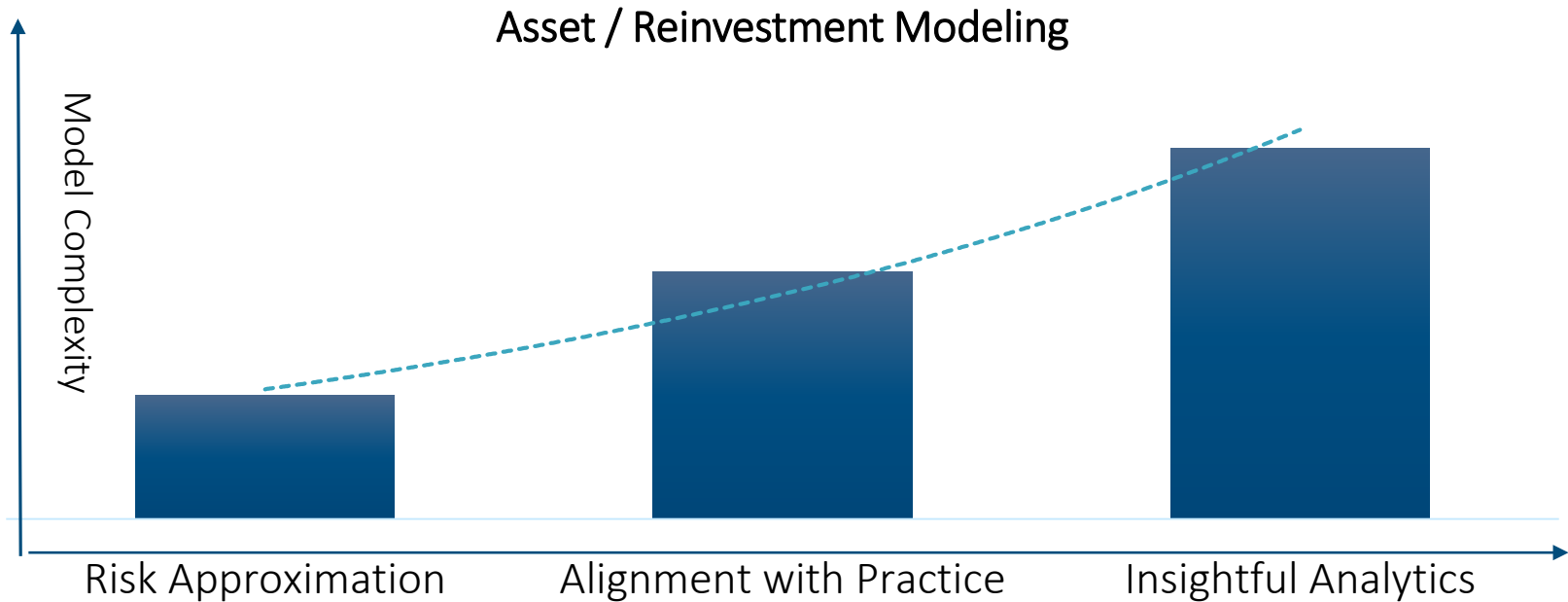
- **DON'T** discuss your own, your firm's, or others' prices or fees for service, or anything that might affect prices or fees, such as costs, discounts, terms of sale, or profit margins.
- **DON'T** stay at a meeting where any such price talk occurs.
- **DON'T** make public announcements or statements about your own or your firm's prices or fees, or those of competitors, at any SOA meeting or activity.
- **DON'T** talk about what other entities or their members or employees plan to do in particular geographic or product markets or with particular customers.
- **DON'T** speak or act on behalf of the SOA or any of its committees unless specifically authorized to do so.
- **DO** alert SOA staff or legal counsel about any concerns regarding proposed statements to be made by the association on behalf of a committee or section.
- **DO** consult with your own legal counsel or the SOA before raising any matter or making any statement that you think may involve competitively sensitive information.
- **DO** be alert to improper activities, and don't participate if you think something is improper.

If you have specific questions, seek guidance from your own legal counsel or from the SOA's Executive Director or legal counsel.

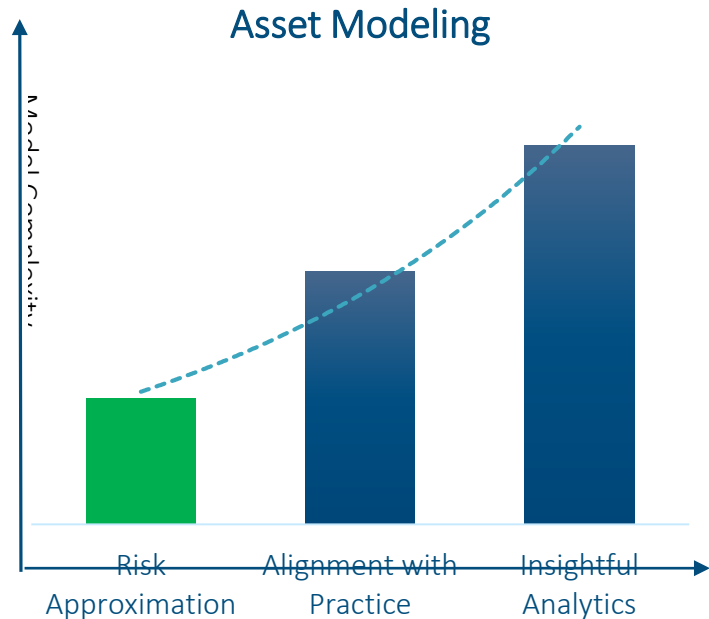
Presentation Disclaimer

Presentations are intended for educational purposes only and do not replace independent professional judgment. Statements of fact and opinions expressed are those of the participants individually and, unless expressly stated to the contrary, are not the opinion or position of the Society of Actuaries, its cosponsors or its committees. The Society of Actuaries does not endorse or approve, and assumes no responsibility for, the content, accuracy or completeness of the information presented. Attendees should note that the sessions are audio-recorded and may be published in various media, including print, audio and video formats without further notice.

Three Stages for ALM Modeling



Risk Approximations



- Compliance with internal and external requirements
- Approximation of key risks
- Simplified modeling approaches
- Conservatism often necessary

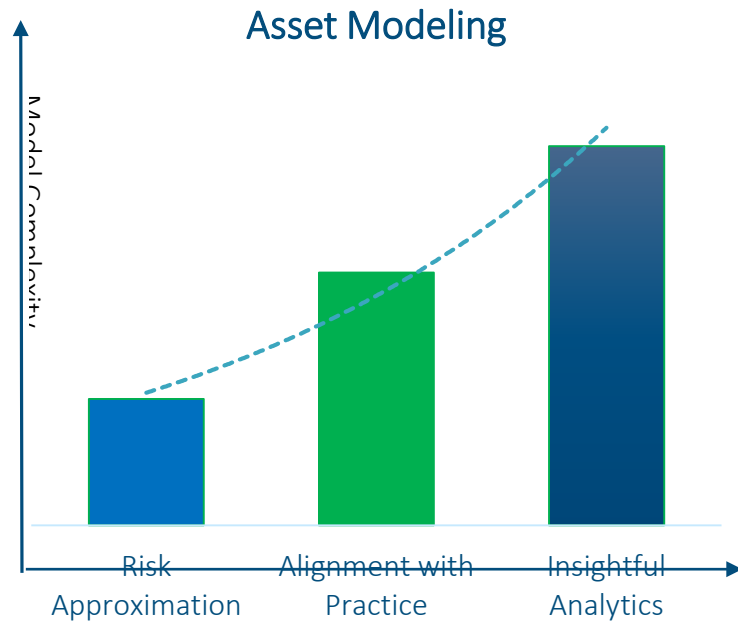
Key Economic Assumptions and Risks

- Assumptions
 - Interest rate, credit spread
 - Equity returns
 - Investment expenses, default costs
 - Call / prepayment assumptions
- Risks
 - Interest rate risk, spread risk, credit risk
 - Equity-related risk
 - Liquidity risk

Simplified Modeling Approaches

- Reinvestment algorithms
 - Borrowing and lending cash at appropriate rates
 - Negative asset purchases
 - Proportional asset sales
 - Simple reinvestment assets such as zero coupon bonds
- Asset modeling
 - May select assets with more predictable cashflows
 - Market value of derivatives estimated using scenario cash flows
 - Policy loans modeled as a percentage of cash value

Alignment with Practice



- Reflect company practice
- More sophisticated modeling techniques
- Adding value as conservatism less needed

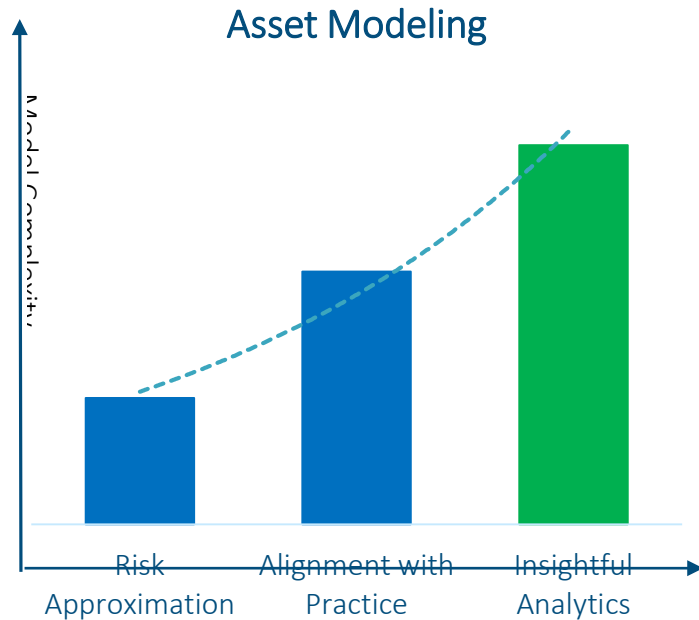
More Realistic Reinvestment Algorithms

- Duration matching strategies
- Apply net cash flows to approach target allocation
 - Target allocations may vary over time
 - Combine duration matching with target allocation
- Actively manage % of selected assets such as alternatives
- Reinvestment assets more representative of existing assets
- Utilize interest rate swaps to manage interest risks
- Additional asset sale criteria
 - Asset group, maturity, book yield, realized gain/loss, liquidity index

Improved Modeling of Assets

- More granular asset groupings to allow for different reinvestment treatments
- Refined estimates of derivatives and structured assets, such as:
 - Treatment of swap margin accounts for reinvestment
 - Market value estimated assuming current interest rates are fixed
- Policy loan projection varies by interest paths
- Detailed reporting on reinvestment activities and asset categories
- Modeling of defaults and rating transitions

Insightful Analytics



- Goes beyond current practice
- Insights can lead to impact
- Innovative modeling approaches and process

What-if Analytics with Options and Accuracy

- Goes beyond current practice by providing what-if analytics
 - e.g., Implementing alternative swap deals to gain insights of their impact
- Combine different reinvestment algorithms
 - Duration matching, cash flow matching, and target allocation
- Duration matching on different metrics
 - Dollar duration or duration in years
 - Key Rate durations
 - Durations calculated with percentages of tail cash flows
- Market value of derivatives calculated using option pricing approaches

Agile Structure and Process

- Internal asset modeling offers great flexibility
 - More reliable nested asset-liability projection capability
 - Much smaller model input files
 - Quick turn-arounds
- Innovative processes and tools to meet ever-increasing user needs
 - Flexible projection process to dynamically construct base and sensitivity runs
 - Separation of liability and asset projection to reduce operational complexity and enhance efficiencies
 - Tools to quickly build models with variety of input controlled by users
- Collaboration among Modeling and Investment teams



**SOCIETY OF
ACTUARIES®**