Reviewing, Validating and Auditing Actuarial Models

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Session Overview

- Introduction to the modeling process
- Basic modeling considerations
- Static and dynamic validation
- Case studies
  - Static validation
  - Dynamic validation
- Auditing of models
- Preventing modeling issues
- Q & A

Introduction to the Modeling Process

- Information gathering

- Resource organization

- Model building

- Results development

- Analyzing the results

- Capitalizing on the process

Basic Modeling Considerations

- Need to determine the purpose of your model
- Various models need differing levels of granularity
- Will your model have an impact on the company financials?

Static Validation - Liabilities

- Confirms that your model is starting from the right place

- Checking that "Inventory" items are properly matched to reported financials

- Normally done on a "Model Plan" basis
    - Often these model plans need some adjustment periodically due to changes in inforce

Static Validation - Liabilities (continued)

- What are reasonable tolerances?
- There are no absolutes here – it is a judgment call on the part of the modeler and the purpose of the model
- Done on a model plan, line of business and entire company basis.
- Certain items should be at 100%
  – Policy count, units
- Tolerance tightens for larger, more significant plans and lines of business

Static Validation – Liabilities (continued)

- Rules of thumb for model-to-actual criteria
- There will often be a plan that is a combination of policies that do not model well
- Often a model must be fine-tuned in order to validate to a desired tolerance

Static Validation - Assets

- Can be modeled or input directly from an external system such as BondEdge

- Some assets may need to be "top-side" adjustments because they are not modeled well by many commercial systems

- Process is similar to that for liabilities in that you are matching back to "inventory" items

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Static Validation – Assets (continued)

- Items to validate
  - Bonds
    - Book value, market value, coupon rates, maturity date, call provisions, YTM, quality, sinking fund provisions
  - Equities
    - Market value, cost, dividend, div and equity growth rate
  - Commercial Mortgages
    - Term, annual payment, balloon payment
  - Adjustable Rates
    - Index, caps and floors, spread to maturity

Polling Question

How often do you perform static validation?

a) Every time the model is run

b) Monthly

c) Quarterly

d) Annually

e) Never

Dynamic Validation - Liabilities

- Reasonableness review of the progression of selected income statement items
  - Premium, investment income, surrender charges, loads, claims, expenses, dividends, profit
- Split by major plan/project and in total
- Compare 3-5 year trend of actual to projected
- If modeling software allows, backcasting recommended
- Often highlights assumption problems
  - Lapses, surrenders, premium persistency, annuitization levels

Dynamic Validation – Assets

- Assumptions needing careful consideration
  - Quality impact
    - Default possibility and accompanying logic for adjustment
    - Moody's as a possible source
    - Need to develop a methodology for upgrades/downgrades
  - Investment Expenses
  - Prepayment Risk
  - Reinvestment Policy
    - How to handle excess or deficient cash flows
      - Positive ➡ reinvest
      - Negative ➡ borrow, sell assets or buy negative assets
- Need to verify that cash flows compare favorably with actual reported

Dynamic Validation – Assets and Liabilities

- Additional assumptions that impact projected results

- Policyholder behavior

- Investment behavior

- Economic climate and its corresponding impact on asset performance

- Management behavior
  - This can be especially important because your model results will be sensitive to your assumption on
    - Investment and reinvestment policy
    - Credited rates and spreads for interest sensitive plans

Dynamic Validation – Assets and Liabilities

- Actual Validation
  - Project 3-5 years and determine "fit" with past reported income and balance sheet items
  - May need to include a level of new business to get comfortable with results
  - Often the most time consuming part of the process because of all of the moving parts
  - Defined percentage validation targets usually difficult to achieve
  - Definitely more of an art than a science

Polling Question

How often do you perform dynamic validation?

a) Every time the model is run

b) Monthly

c) Quarterly

d) Annually

e) Never

Case Study

- Walden Life Insurance Company is preparing for annual cash flow testing on their life insurance block

- In accordance with best practices, they validate their model prior to using the results

- They perform the following checks:
  - Static validation
  - Dynamic validation

- Start with deterministic liability-only model before moving to stochastic and/or asset models

Polling Question

Where do you look for guidance related to model validation?

a) Industry meetings & research

b) Regulatory guidance

c) Consultants

d) Auditors

e) All of the above

f) N/A – wing it

Static Validation

Liability Static Validation – Case Study
As of December 31, 2014

		Universal Life			Variable Universal Life		
		Extract	Model	Validation	Extract	Model	Validation
Policy Values	Count	2,619	2,451	93.6%	341	341	100.0%
	Face Amount	505,340,227	473,503,792	93.7%	65,694,229	65,694,229	100.0%
	Cash Value	197,082,688	186,243,141	94.5%	25,620,749	25,415,783	99.2%
	Policy Loans	17,737,442	17,400,431	98.1%	2,305,867	2,298,950	99.7%
Reported Amounts	Stat Reserve	252,670,113	208,958,184	82.7%	32,847,115	32,781,421	99.8%
	Tax Reserve	237,509,907	197,370,732	83.1%	30,876,288	30,845,412	99.9%
	Target Surplus	17,686,908	14,043,405	79.4%	2,299,298	2,292,400	99.7%

Polling question

Which line(s) of business would you investigate?

a) Universal life

b) Variable universal life

c) Both

d) Neither

Case Study - Discussion Topic

What would you look into to remediate any static validation issues?

Liability Static Validation – by plan code

		Policy Count			Face Amount		
		Extract	Model	Validation	Extract	Model	Validation
Policy Values	Plan Code 1	1,001	1,001	100.0%	193,144,547	193,144,353	100.0%
	Plan Code 2	907	907	100.0%	175,907,097	175,907,096	100.0%
	Plan Code 3	543	543	100.0%	104,452,149	104,452,344	100.0%
	Plan Code 4	168	-	0.0%	31,836,434	-	0.0%
	Total	2,619	2,451		505,340,227	473,503,793	

Static Validation – Steps in Analyzing Results

1	Check thresholds	• Establish reasonable and appropriate thresholds • Identify outliers to investigate
2	Validate actuals	• Ensure that actuals are consistent with reported values, and source data is appropriate (e.g. Statutory Annual Statement) • Review the reliability and quality of source data • Confirm no errors or omissions in input data
3	Analyze model outputs	• Validate feed from model output is correct • Ensure all new policies and plan codes are captured • Review known data adjustments or approximations • Review model documentation related to data limitations • Review model error log • Ensure all plan codes have reasonable balances (e.g. reserve balance/count) • Review policy/cell level validations

Dynamic Validation

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Liability Dynamic Validation – Case Study
As of December 31, 2014

	Variable Universal Life							
	Actual			**Model**			**Actual/Model**	
	2012	2013	2014	2013	2014	2015	2013	2014
Premium	360,663	342,630	322,072	340,925	30,683	28,842	100.5%	1049.7%
Death Claims	410,655	436,867	459,860	459,584	479,634	551,579	105.2%	104.3%
Surrenders	995,715	1,048,122	2,562,075	1,207,250	1,270,789	1,334,329	86.8%	201.6%
COIs/M&E/Policy Charges	284,198	334,351	371,501	281,072	331,676	557,251	119.0%	112.0%

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Polling question

Which cash flows probably do NOT need further study?

a) Premium

b) Death Claims

c) Surrenders

d) COIs/M&E/Policy Charges

e) They all need further study

Case Study - Discussion Topic

What would you look into to remediate any dynamic validation issues?

Results of Research

- Block is in runoff

- Premium – most policies modeled as 10-pay despite actually having ongoing premiums

- Surrenders – internal replacement program in 2014 significantly increased surrenders

- COIs – modeling an increase in COIs in 2015 since death claims have outpaced charges

Dynamic Validation – Steps in Analyzing Results

1	Check thresholds	• Establish reasonable and appropriate thresholds (probably broader than static validation since more moving parts) • Identify outliers to investigate
2	Validate actuals	• Ensure that actuals are consistent with reported values • Dynamic validation tends to be more granular so may need to go back to income statement, not just blue book
3	Analyze model outputs	• Depending on item being validated, reason for discrepancy could vary dramatically: product features, assumptions, etc. • Compare actual to projected by year, looking at both same year comparisons and trends • Requires a deeper understanding of the product

Case Study - Discussion Topic

If your model contained stochastic scenarios as well, what else would you look at to validate it?

Auditing of Models

- Planning
  - Test plan / strategy, methodologies employed
  - Sources of data (administration system, pricing documents, assumption sign-off memos)
  - Model inventory
  - End to end process (including inputs and back-end models)
- Execution
  - Replicating the code, traceable results
  - Analysis of alternatives
  - Detailed explanations (beyond just "reasonable")
- Sign-off

Preventing Modeling Issues

Model Changes

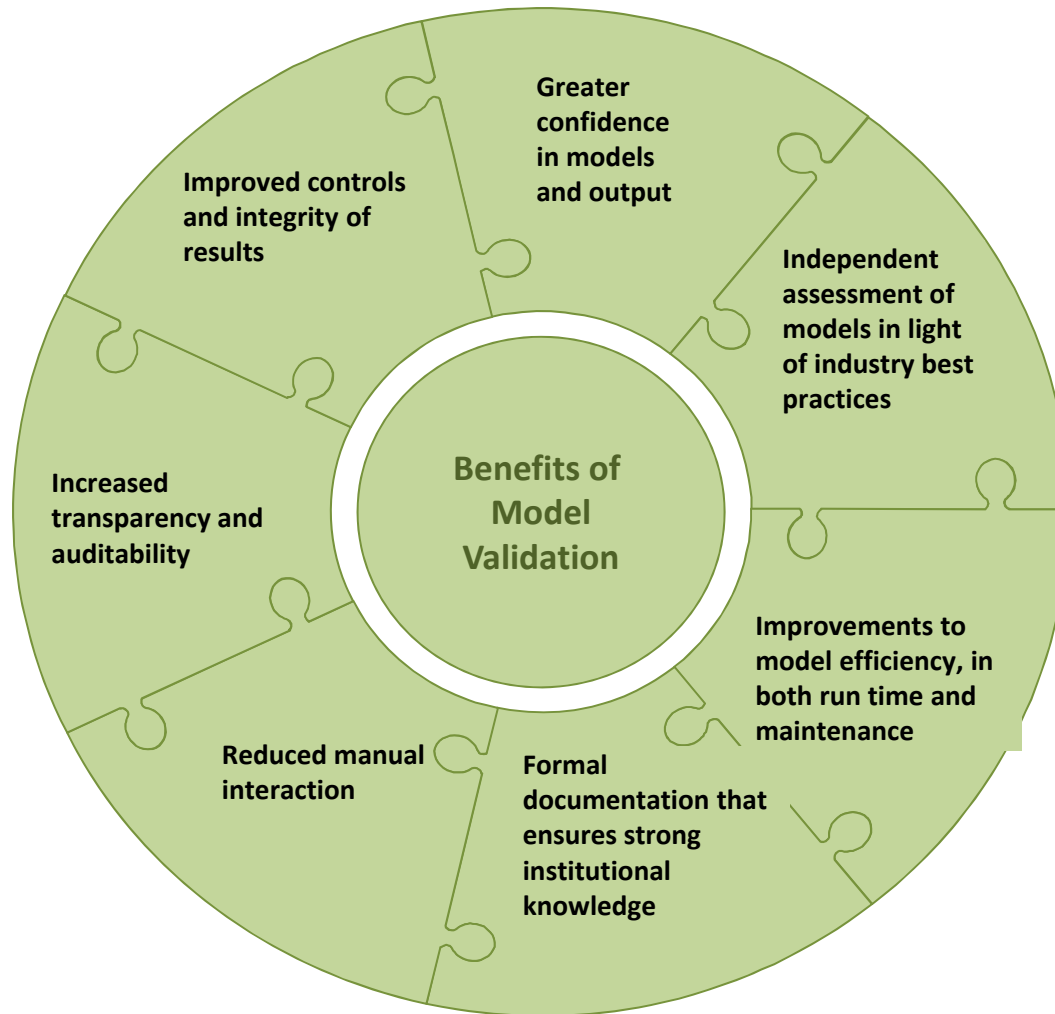Many reasons model changes may be required:

- Structural changes to underlying data

- Structural changes to assumptions

- Model efficiency or architecture changes

- New products or pricing

- Inforce management/Changes to existing product features

- New methodologies or functionality needed

- Strategic business changes

- Other

Keeping up with business changes

Planning or pre-close meetings to understand business changes and their impact on supporting models

- ➢ New products or changes in existing product features

- ➢ New or updated reinsurance contracts

- ➢ Business changes

  - ➢ For example, marketing strategy, one time expenses, etc

- ➢ Changes in accounting methodology

- ➢ New business requirements or reporting needed

Ongoing Model Validation

Benefits of Model Validation

- Greater confidence in models and output
- Independent assessment of models in light of industry best practices
- Improvements to model efficiency, in both run time and maintenance
- Formal documentation that ensures strong institutional knowledge
- Reduced manual interaction
- Increased transparency and auditability
- Improved controls and integrity of results

Validation – Going back to the source

- Product specs

- Pricing review memos

- Product features grid/database

- Assumption development memo

- Assumption database

- Model development documentation and user manuals

- Prior testing documentation

- Documentation and testing related to upstream models

Analytics and Testing

- **Dynamic validation:** Identify disconnects between actual results and model projections

- **Static validation:** Confirm model coverage and compression

- **Control totals:** Check totals for key values and model logic flows at all hand-off points in the process

- **Key ratios and checks:** E.g., reserves per unit, statutory-to-GAAP reserves, claims-to-premium

- **Rollforwards:** Steps explaining the projected or actual change in balances (e.g., account value, DAC) with the goal of confirming the reasonableness of each step

- **Attribution analysis:** Analyses to explain complex movements in assets and liabilities

- **Sources of earnings:** Identify drivers of profits/losses

- **Regression testing:** Confirm code changes do not have unintended impacts

- **Parallel testing:** Testing the calculations through use of an independent model

- **Extreme value testing:** Check that the model is performing as intended when invalid data or extreme (boundary) data values are used

- **Sensitivity testing:** Custom sensitivities to gauge the reasonableness of the model and assist with understanding and forecasting results

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Components of Model Documentation

Purpose

Define the business use for the model

Scope

Products covered, model platform, model owner

Process

Overview of the end to end process the model fits into

Limitations

Describe any model use limitations

Inputs

Identify all inputs as well as their source and owner

Support Docs

Outline all other supporting documents

Component

Describe model components and the basis for calculation

Testing

Describe the test plan and the results of testing performed

Sign-off

Evidence of model review sign-off

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Remember to complete the evaluation:

http://soa.qualtrics.com/SE/?SID=SV_d7mWdiP9mYjZe1n