

## Actuarial & Finance

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# Actuarial Model Risk Management

# Speaker Introduction

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# Agenda

- Definitions and Overview of Model Risk Management Practice
- Risk Management Considerations: First Principles vs Claim Costs Models
- Model Validation under LDTI and Implications for LTC
- Model Risk Considerations in Practice

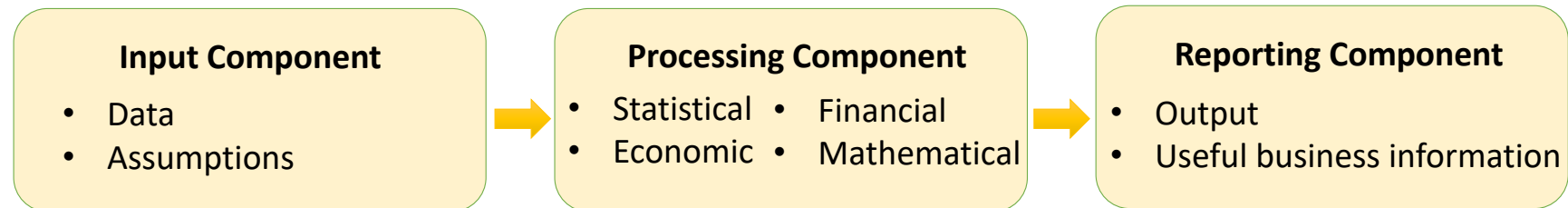
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# Definitions and Overview of Model Risk Management Practice

## Model

According to the U.S. Federal Reserve and Office of the Comptroller of the Currency (OCC)'s Supervisory Guidance, a model is a quantitative method, system or approach that applies theories, techniques, and assumptions to process input data into quantitative estimates.



## Model Risk

According to Capital Requirements Directive IV (CRD IV), Article 3.1.11, “model risk” means the potential loss an institution may incur, as a consequence of decisions that could be principally based on the output of internal models, due to errors in the development, implementation or use of such models

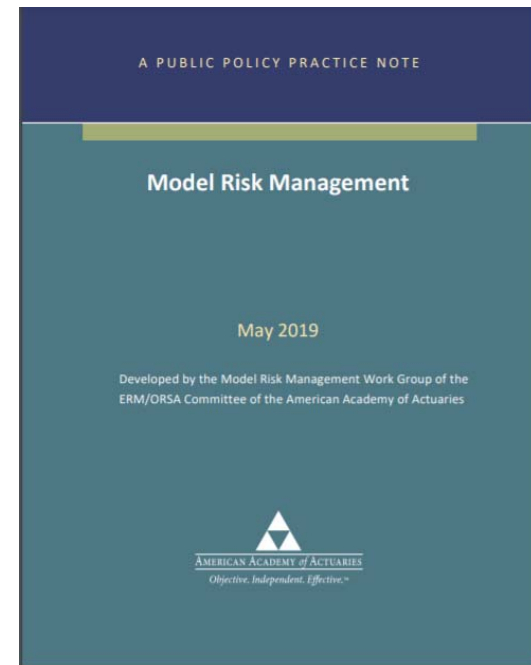
### Four basis sources of model risk

- Data limitations, availability and quality
- Estimation uncertainty or methodological flaws
- Calculation or coding error
- Inappropriate use of a model

# Definitions and Overview of Model Risk Management Practice

## Model Risk Management Practice

- Model risk policy and governance
  - Three lines of defense framework:
    - First line: Business modelers
    - Second line: ERM, Risk committee, Compliance
    - Third line: Internal audit
- Model inventory
- Model documentation
- Model process and control
- Model risk scoring/measurement
- Model development and implementation
- Model review/validation
- Performance monitoring



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# First Principles vs. Claim Cost Models

- Model approach – compare and contrast
  - Claim cost
    - Older method originally applied due to systems limitations.
    - Separate model develops the amounts needed to settle a claim which are then input to the reserving or projection model
    - Total Lives Model
  - First Principles model
    - Assumptions are all developed and projected in a single model to determine reserves or project cash flows
    - Tracks the state of a policy including healthy (active) or disabled (on claim).
    - Some models will also track the initial situs of care and may possibly track transitions between situses of care such as nursing home, home health, and assisted living facility. These may be referred to as multi-state models.



# Polling Question No. 1

- Question: Is your LTC model a First Principles model or a Claim Cost model?
- Answer:
  - 1. First Principles
  - 2. Claim Cost
  - 3. Varies by product blocks (e.g. Individual vs. Group)
  - 4. Varies by purpose (e.g. best estimate projection model vs. locked-in Statutory reserves)

# First Principles vs. Claim Cost Models

- Risk management considerations

Topic	Claim Cost	First Principles
Assumption Governance	<p>How is experience monitored and is there a good understanding of sources of variation within the claim cost?</p> <p>What are the underlying assumptions used in developing claim costs?</p> <p>How are claim costs adjusted for emerging experience?</p>	<p>Improved transparency since assumptions are no longer bundled</p> <p>Is there a good understanding by management of the underlying assumptions &amp; experience study methodologies needed for setting assumptions to use in first principles models?</p> <p>Example: Experience studies healthy lives vs disabled lives</p>

# First Principles vs. Claim Cost Models

- Risk management considerations

Topic	Claim Cost	First Principles
Model Validation	<p>Easier to validate models due to the simpler calculation</p> <p>What simplifications are applied in the model? Use of scalar claim cost factors is a common approach.</p>	<p>More time and effort needed to replicate the model calculations</p> <ul style="list-style-type: none"> <li>- Unbundled assumptions</li> <li>- Tracking status of policy (active vs. disabled)</li> </ul> <p>What simplifications are applied in the model?</p>
Model Performance	<p>Difficulty in understanding reasons for variations from expected</p> <p>Bundling of assumptions could mask issues</p>	<p>Allows for improved analytics and trend analysis to monitor model performance and identify issues</p>

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# Long Duration Targeted Improvement (LDTI) Overview

AREA OF FOCUS	TARGET	IMPROVEMENT
Liability for future policy benefits	Original assumptions remain "locked"	Assumptions periodically reviewed or updated, increasing relevance
	Discount rate is the insurer's expected investment yield	Discount rate is upper-medium grade (low-credit-risk) fixed-income instrument yield
Market risk benefits	Two measurement models	One measurement model, improving uniformity
Deferred acquisition costs	Complex amortization	Simplified amortization, increasing understandability
Disclosures	Limited disclosures	Enhanced disclosures

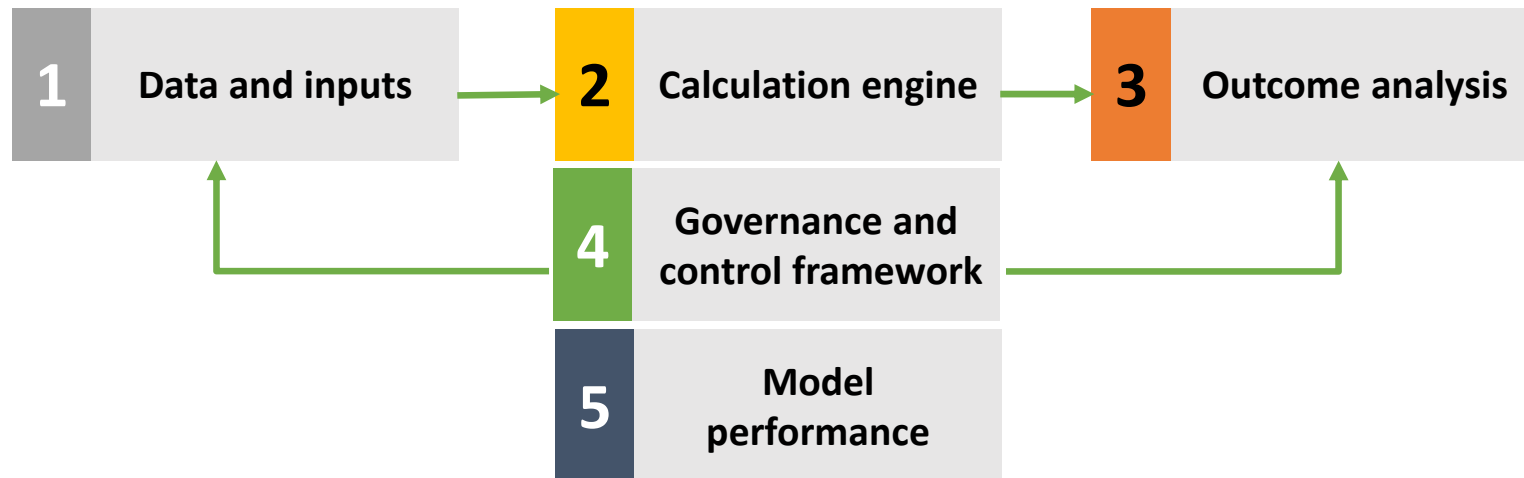
Source: FASB In Focus: Targeted improvements to the accounting for long-duration contracts issued by insurance companies

# Polling Question No. 2

- Question: Is your organization impacted by LDTI?
- Answer:
  - 1. Yes, my organization is a public company with US GAAP reporting
  - 2. Yes, my organization is a private or mutual company with US GAAP reporting
  - 3. No

# Model Validation under LDTI

- Model validation components



# Model Validation under LDTI and Implications for LTC

## 1

### Data and inputs

- Data inputs consistent with unit of account and issue year cohorts
- Best estimate assumption inputs are used for the projection of future cash flows
- Experience developed to support input assumptions reviewed annually with updates to assumptions, as needed
- Discount rates based on single A or locked-in at transition rates for income statement purposes or current single A for balance sheet purposes (AOCI)



# Model Validation under LDTI and Implications for LTC

## 2 Calculation engine

- Net Premium Ratio (NPR) unlocking process for Liability for Future Policy Benefits (LFPB)
- LFPB includes the Active Life Reserve and Disabled Life Reserve
- LFPB calculations performed at issue year cohort level with NPR capped at 100%
- DAC amortized on a constant basis over the expected life of the contract

# Model Validation under LDTI and Implications for LTC

## 3 Outcome analysis

- Tailored to the LDTI implementation and scope of the validation.
- Examples include performing trend analysis, stress tests, or reasonability checks

# Model Validation under LDTI and Implications for LTC

## 4

### Governance and control framework

- Controls infrastructure should be in place to gain comfort of the end-to-end process
- Assumption governance in place to ensure effective review and challenge for the annual assumption review

# Model Validation under LDTI and Implications for LTC

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## Model performance

- Evaluate model performance for dependability and ability to produce results that meet close schedule
- Evaluate manual efforts and identify opportunities for increasing level of automation (e.g., process for incorporating actual historical cash flows)

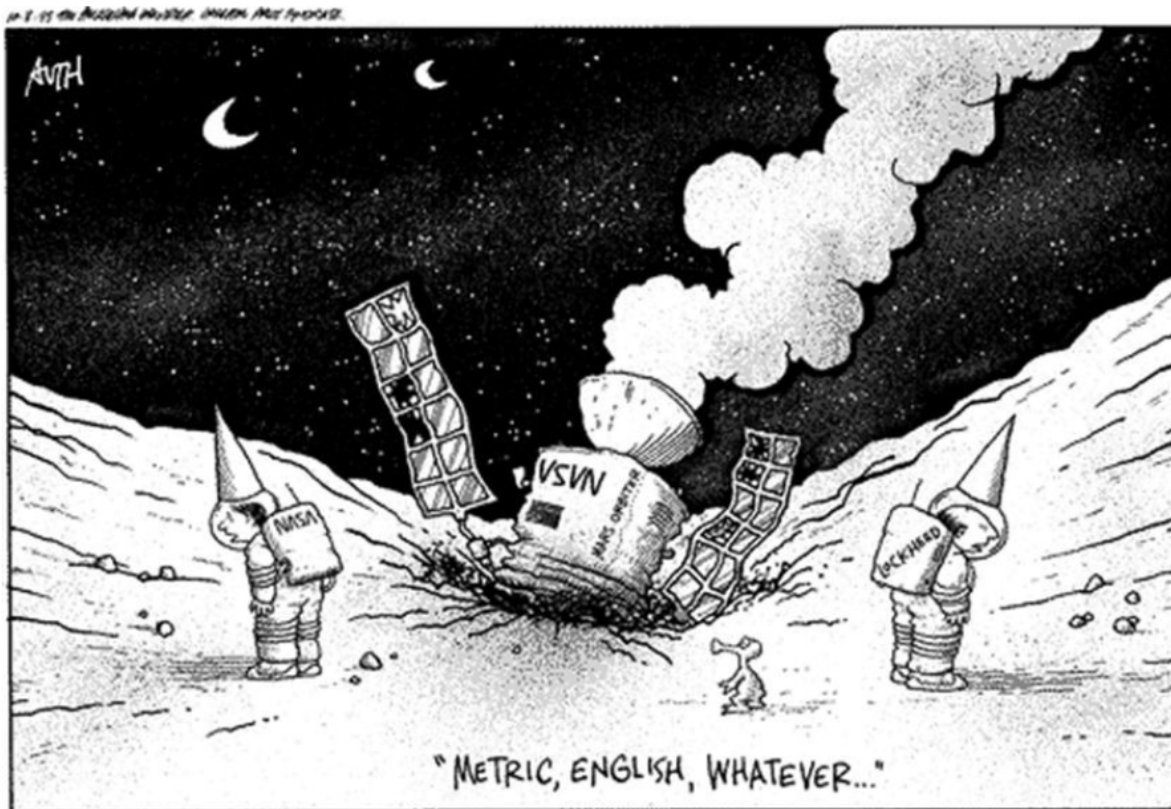
# Polling Question No. 3

- Question: When was the last time your organization performed a formal model validation?
- Answer:
  - 1. Within the last year
  - 2. Within the last three years
  - 3. Within the last five years
  - 4. More than five years ago
  - 5. Not sure / not applicable

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# Model Risk Considerations in Practice



- **Background:** In 1999, NASA lost a \$125 million Mars Climate Orbiter (MCO). The trajectory of the spacecraft had been incorrectly calculated, the spacecraft got too close to Mars and disintegrated in the planet's atmosphere.
- **Root cause:** External contractor produced a software with crucial operation data in English unit, the navigation team at NASA mistook the data as being in the required metric units.

**Remember the Mars Climate Orbiter incident from 1999?**

# Model Risk Considerations in Practice

## Lessons learned from NASA's lost spacecraft

- Inadequate data quality control: the navigation data was not converted into the correct unit.
- Inappropriate data is a common source of model risk.
- We all know: Garbage in, garbage



## Examples of inconsistent data of LTC models:

- Inconsistency between assumption development vs. application:
  - Situs as of end of elimination period vs. beginning of elimination period;
  - Benefit inflation option at inception vs. current for landing spot policies.
- Inconsistency between extract data unit and model unit:
  - Daily maximum benefit, vs. monthly maximum benefit.



# Model Risk Considerations in Practice

## Lessons learned from NASA's lost spacecraft

- While it was indisputable that the human error in not converting the data to the agreed-upon unit was the root cause, is this only a data issue here?

Dr. Edward Weiler  
NASA's Associate Administrator for Space Science

"People sometimes make errors. The problem here was not the error, it was the failure of NASA's systems engineering, and the checks and balances in our processes to detect the error. That's why we lost the spacecraft."

Dr. Edward Stone  
Director of NASA's Jet Propulsion Laboratory

"Our inability to recognize and correct this simple error has had major implications."

Dr. Carl Pilcher  
NASA's Science Director for Solar System Exploration

"People make mistakes all the time, I think the problem was that our systems designed to recognize and correct human error failed us."

# Model Risk Considerations in Practice

## Mars Climate Orbiter Mishap Investigation Board Findings

- Verification and validation processes did not verify that navigation software met requirements
  - The documentation in place specified that the results should be supplied in metric units
  - Neither the programmers who developed the software nor the testing team properly used the documentation
  - The investigation board found no evidence of complete, end-to-end testing for the software, and they could not determine whether independent verification and validation had been performed on the software in question

## Considerations for Actuarial Models

- Use existing documentation effectively, don't ignore them. Model documentation is created to improve model transparency and enable knowledge transfer
- When making a model change, need to verify that what is in the business requirement has been done and done correctly
- When making model changes, especially complicated ones involving input and/or output changes, an end-to-end testing is essential. Result of the end-to-end testing should be documented for future reference

# Model Risk Considerations in Practice

## Mars Climate Orbiter Mishap Investigation Board Findings

- There was little cross-communication or shared understanding between various teams on the project
  - The navigation team discussed concerns about the MCO's trajectory among themselves, they did not fully communicate their concerns to the spacecraft operations team or project management
  - Team members relied on informal communication channels rather than using standard methods for reporting concerns
  - Teams worked in silos

## Considerations for Actuarial Models

- The model development process should allow and facilitate open communication across all stakeholders
- Staff at all levels should be empowered to elevate any concern
- For LTC, communication is critical when implementing modification to the original contract triggered by rate increase, to ensure common understanding of the rate increase alternatives among inforce management, administration system, IT, experience study, model development, valuation and finance.

# Model Risk Considerations in Practice

## Mars Climate Orbiter Mishap Investigation Board Findings

- The need to shift in culture, need to set the right tone at the top
  - The MCO mission was conducted under NASA's "Faster, Better, Cheaper" philosophy, which failed to instill sufficient rigor in risk management throughout the mission lifecycle
  - With the lessons learned, NASA put forth a new vision, Mission Success First, which entailed a new NASA culture and new methods of managing projects
  - All individuals should feel ownership and accountability, not only for their own work, but for the success of the entire mission

## Considerations for Actuarial Models

- Create a cultural environment in which all individuals supporting the model usage and model development take accountability for the quality and success of both the output and outcomes of the work product
- Ensure an appropriate culture and mind set is maintained despite cost and time constraints.
  - This is extremely important when working on projects/analysis with limited resource and tight timeline
- Emphasize adherence to established procedures, even for seemingly routine tasks

# Q&A

*Please feel free to email us if there are questions after the session!*

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