Moody's Analytics

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# Health and Combo Product Modeling Challenges and Solutions

SEAC June 2023

# What are Health and Combo Products?

## PRODUCTS THAT…

- Pay ongoing benefits
- Pay multiple types of benefits
- Pay interdependent benefits
- Pay benefits to multiple lives
- Pay benefits depending on “where” a policyholder is

## EXAMPLES…

- Critical Illness (CI)
- Short Term Disability, Long Term Disability, Accident and Sickness, Group Benefits, Worksite Benefits
- Long Term Care (LTC)
- Accelerated Benefits, Whole Life/UL+LTC Rider

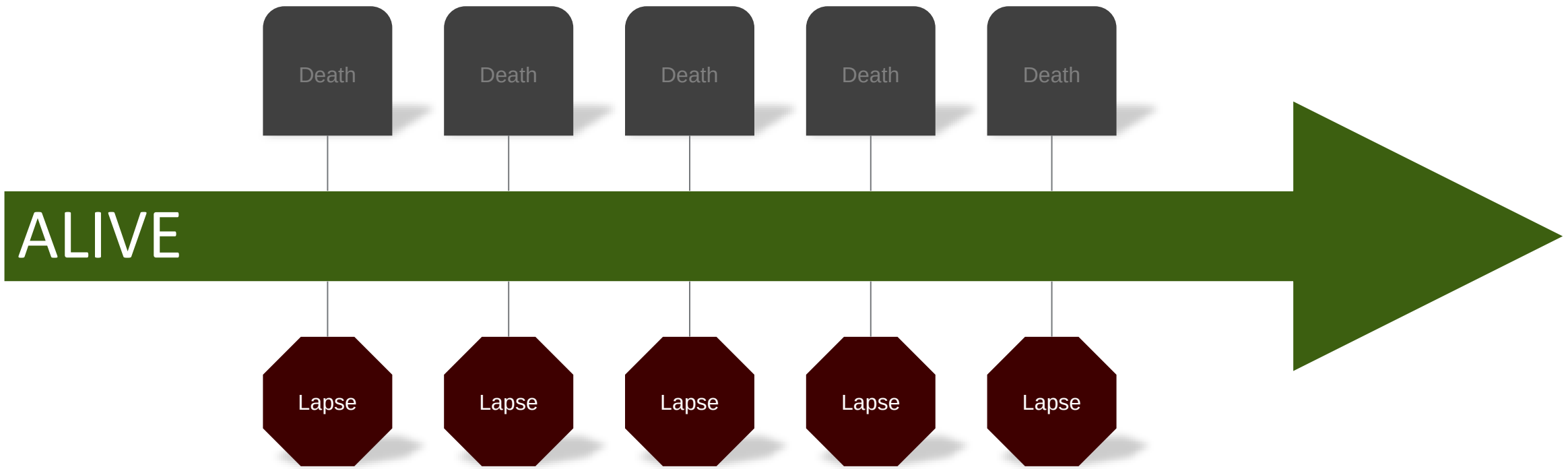
## KEY FEATURES…

- Premium Waiver
- Living Benefits with Min/Max/Waiting Periods
- Benefit Caps
- Shared Care
- Extension of Benefits
- Residual Benefits
- Restoration of Benefits

# Standard Life and Annuity Models

## WHEN MODELING LIFE AND ANNUITY BUSINESS A "SINGLE STATE MODEL" IS OFTEN SUFFICIENT

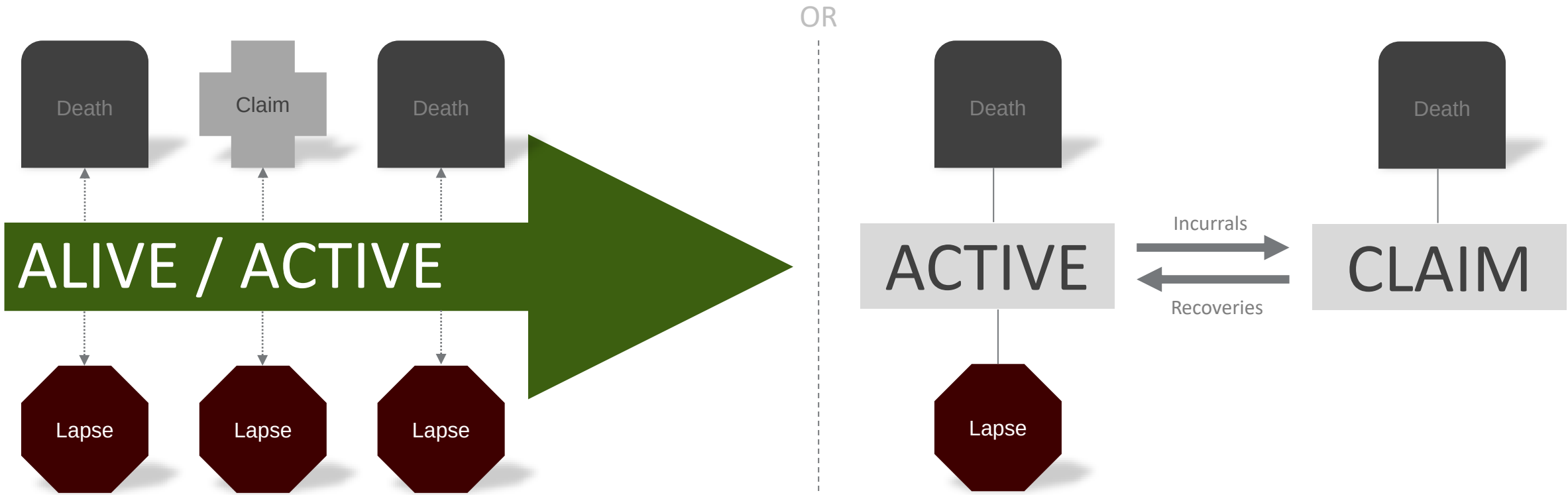
A policyholder is either "alive" (ie. "alive" is the single state) or has been removed from the projection due to death, lapse, single incidence, etc…



# Simple Health Models

## WHEN MODELING LIFE AND ANNUITY BUSINESS A "SINGLE STATE MODEL" IS OFTEN SUFFICIENT

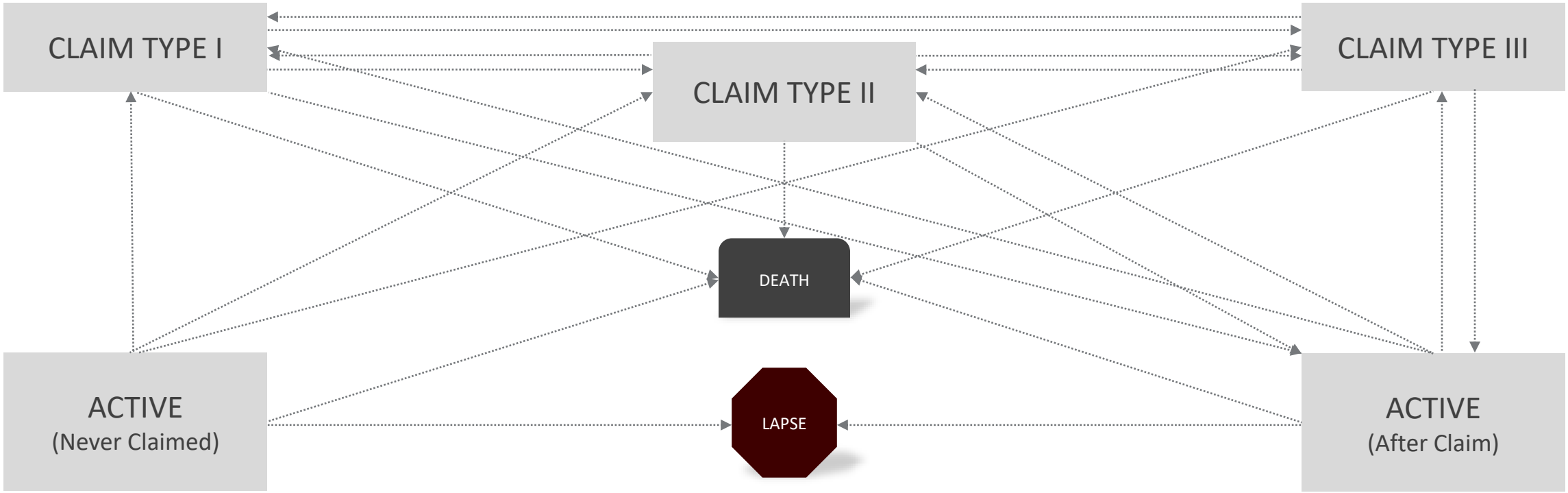
The claim state may be modeled explicitly, or a "claims cost approach" might be used. Often we need at least two states: "active" and "claim". Recoveries from the claim to active state may or may not be modeled



# More Complex Health and Combo Product Models

## WHEN MODELING LIFE AND ANNUITY BUSINESS A "SINGLE STATE MODEL" IS OFTEN SUFFICIENT

States are modeled explicitly – no "claims cost approaches". Often a desirable model would include at least three states – "active never claimed", "claim" and "active after claim". Perhaps a model would also include several claim states – "claim state 1", "claim state 2", "claim state 3", etc…



# Complex Health and Combo Product Modeling Techniques

- Standard actuarial modeling techniques still apply
- Very broadly speaking, same as for life and annuity business
  - Input inforce file, product features and actuarial assumptions; develop holistic probabilistic or stochastic model; output cash flows, reserves, and other income statement and balance sheet items
- Model the inforce population over time, project things into the future
  - Project single “outer loop” path, or multiple nested “inner loops” along single “outer loop”
- Develop resulting cash flows as key output
  - Use cash flow projections as basis for all analyses
- Calculate functions of cash flows, potentially over many scenarios
  - Calculate functions of liability cash flows such as: pricing metrics, reserves, capital
  - Calculate advanced integrated/iterative functions of asset and liability cash flows, e.g., VM-20, BMA reserves
- Stochastic approach is desirable in many cases, particularly when path-dependency is significant

# Probabilistic vs. Stochastic Approaches

- Probabilistic approaches are much more common and familiar, but have significant limitations for multiple-state modeling
  - Move “pieces” of the life being projected between states, remove “pieces” for decrements
  - Attempt to capture every possible path in a single projection
  - This becomes an intractable problem computationally very quickly, as the number of possible paths grows exponentially even for models with a small number of states
  - Approximations are essential
- Stochastic approaches offer significant advantages for multiple-state modeling in many cases
  - For a given stochastic trial, move the “whole” life from state-to-state, based on a Monte Carlo random walk
  - Path-dependency is easily captured within a given trial
  - Running a large number of trials and averaging produces a theoretically better answer than a single probabilistic projection

# Complex Health and Combo Product Modeling Challenges

## LACK OF ASSUMPTIONS

- A multi-state model is clearly better in some cases, but does the company have the data to support a multiple-state transition model
- If yes, model care-type transfers?

## LACK OF MODEL SOPHISTICATION

- Can current systems handle a multiple-state projection model, along with all downstream calculations and reporting
- Multi-state models are naturally slower compared to single state models
- Projecting an “inner loop” along an ”outer loop” in a multiple-state model is calculation-intensive
- Modeling path-dependent benefits in a reasonable manner is tricky and calculation-intensive

## LACK OF SPEED AND EASE OF USE

- Can the solution be run efficiently and easily?
- Multi-state, probabilistic projections can take a long time to run, especially when there’s significant path-dependency
- Models can be hard to use and audit

# Modeling Solutions

## GET BETTER ASSUMPTIONS

- Experience studies
- Consulting partners
- Industry rates

## IMPROVE MODELING APPROACHES

- Move from claim-cost to first principles
- Move from single claim state to multiple claim states with full transition model
- Capture path-dependency of benefits, charges, assumptions, and features
- Model under a Monte Carlo random walk projection approach

## IMPROVE SPEED AND EASE OF USE

- Improve algorithms under probabilistic projections
- Develop better models

# Combo Product Modeling Case Study

- First principles combo product model
- Whole life, with accelerated benefits, and extension of benefits
  - $1000 of face amount
  - Attained age premiums & 100% year 1 commission
  - Attained age incidence rates
  - No recoveries
  - Benefits are accelerated at $10 per month while on claim; health claims reduce death benefit payable
  - Extension of benefits for 0, 5, or 10 years upon exhaustion of original face amount
- Start with basic whole life, build up complexity
- Assess impact of combo product features
- Assess impact of probabilistic vs stochastic runs

# Combo Product Modeling Case Study – Some Results

| Product | Probabilistic | Stochastic 100 | Stochastic 1000 | Stochastic 10000 | Stochastic 20000 | Stochastic 30000+ |
|---|---|---|---|---|---|---|
| Basic WL | (37.7) | (51.1) | (32.7) | (39.6) | (37.7) | (37.7) |
| WL + acceleration | (32.1) | (46.0) | (26.1) | (27.7) | (30.6) | (31.9) |
| WL + acceleration + extension60 | (29.8) | (51.8) | (23.4) | (31.2) | (30.4) | (30.2) |
| WL + acceleration + extension120 | (28.4) | (49.3) | (21.9) | (29.6) | (28.8) | (28.7) |

- Results convergence to the “probabilistic mean”, as the number of stochastic trials increases
- The difference between the probabilistic run, and the 30000+ trial stochastic run is generally quite small, but increases as the path-dependency of the product design increases

# Combo Product Modeling – What's Next?

- Better, more sophisticated and insightful models!
- Improved model controls and governance – combo product models are complicated!
- 2015 AAA LTC Technical Subgroup
  - Stochastic approach recommended
  - Spreadsheets are insufficient – much too slow
  - More work to do – how to comprehensively include all risks? how to validate besides comparison to probabilistic results?
- Engage with your modeling partners!