Life/LTC Combination Products

Modeling Perspectives

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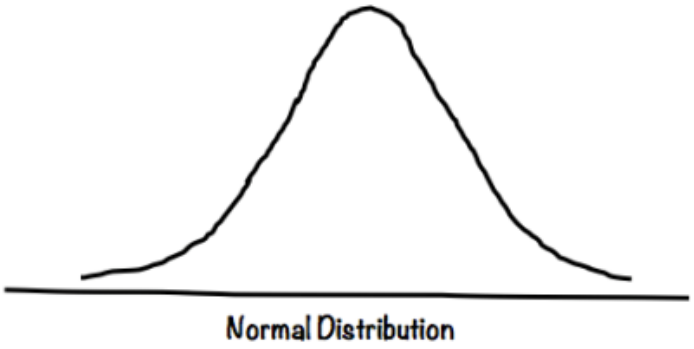
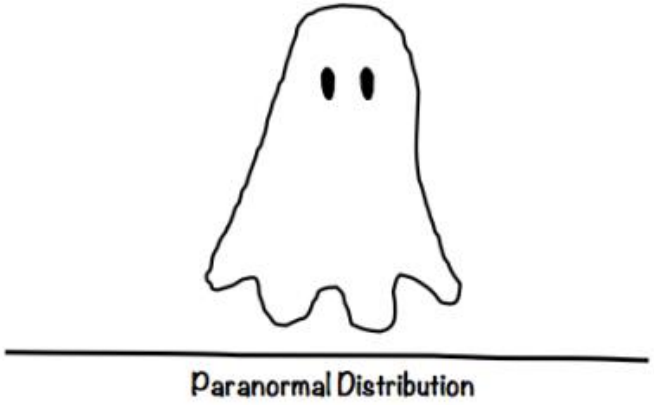
Agenda

- General Modeling Considerations
- Why Build a Stochastic Model?
- What can I do with the Model and the Output?



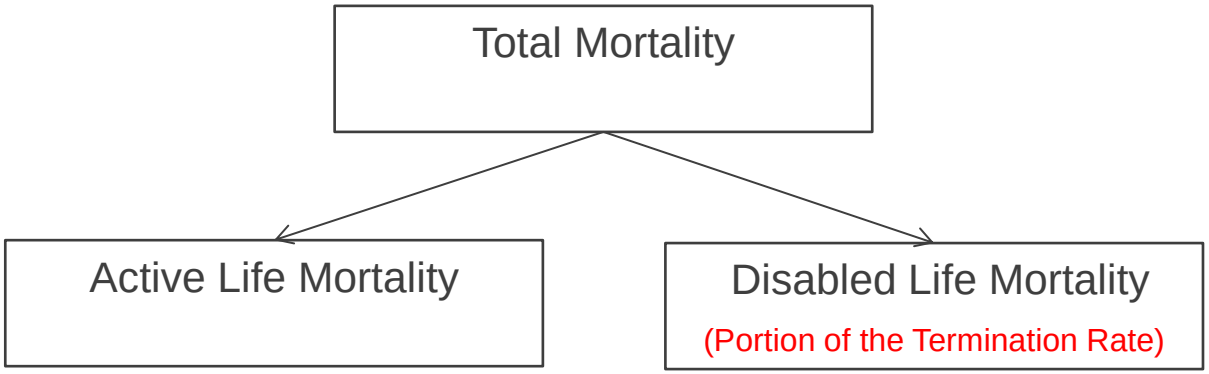


https://mathjokes4mathyfolks.wordpress.com/tag/halloween/

General Modeling Considerations

- Total vs Active Life Mortality
- Assumption Interactions
- Care Path
- Deterministic vs Stochastic

Total vs Active Life Mortality

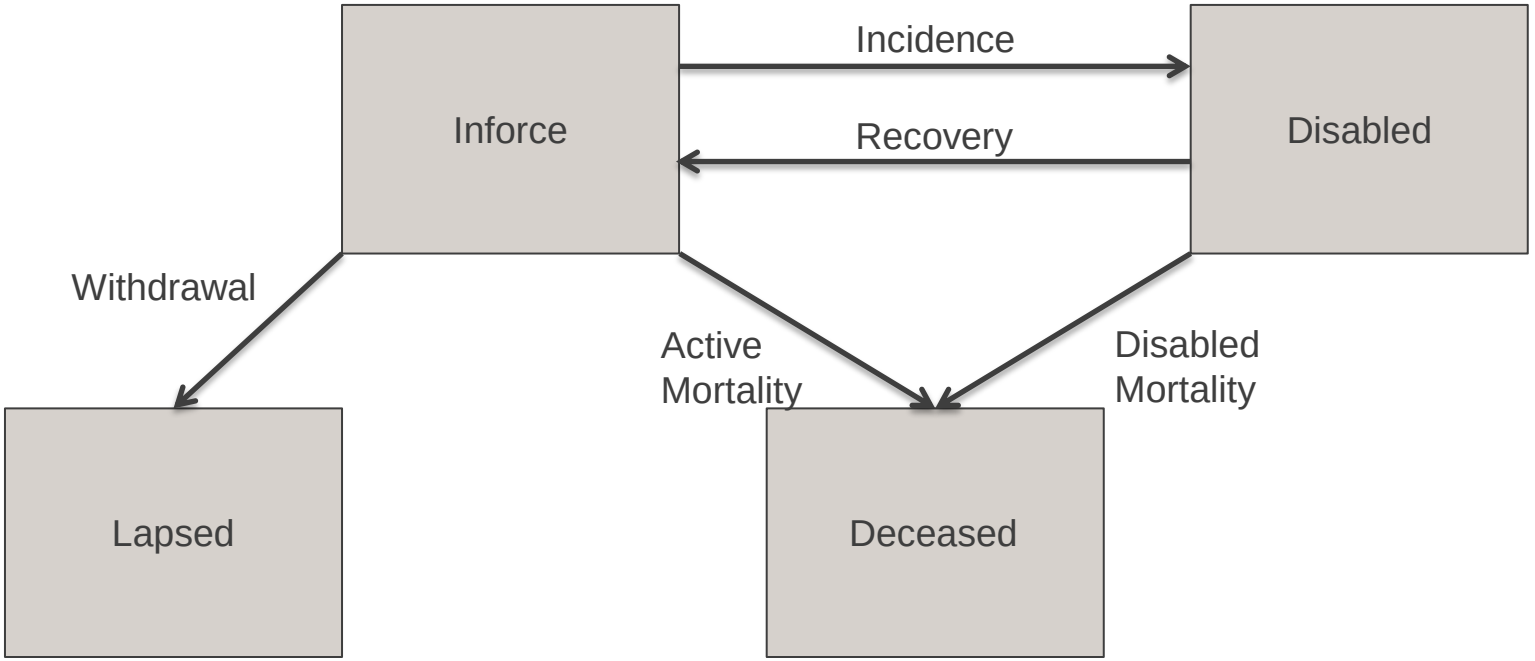


- Two of the three assumptions will be “known”
- Third assumption becomes a balancing item
- Typical mortality experience contains disabled lives
- Not much public data for LTC active life mortality

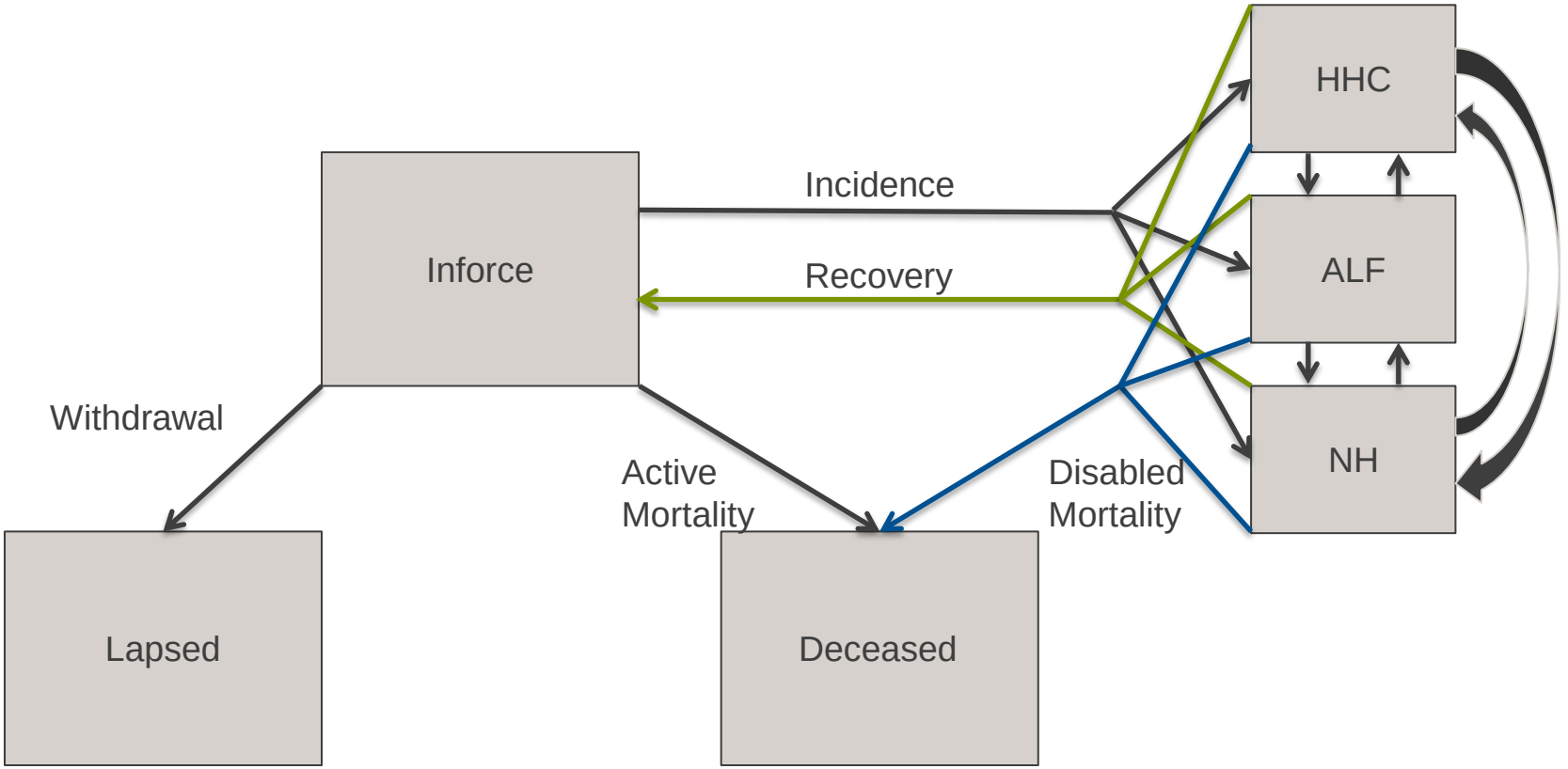
Care Path Modeling

- Typically 3 care paths
- Termination and Recovery rates vary by care path
- Additional Assumptions
- Model sophistication vs model parsimony
  - Do we have enough confidence in the additional assumptions needed that this model sophistication adds value?

Care Path Modeling
Aggregate Care Path

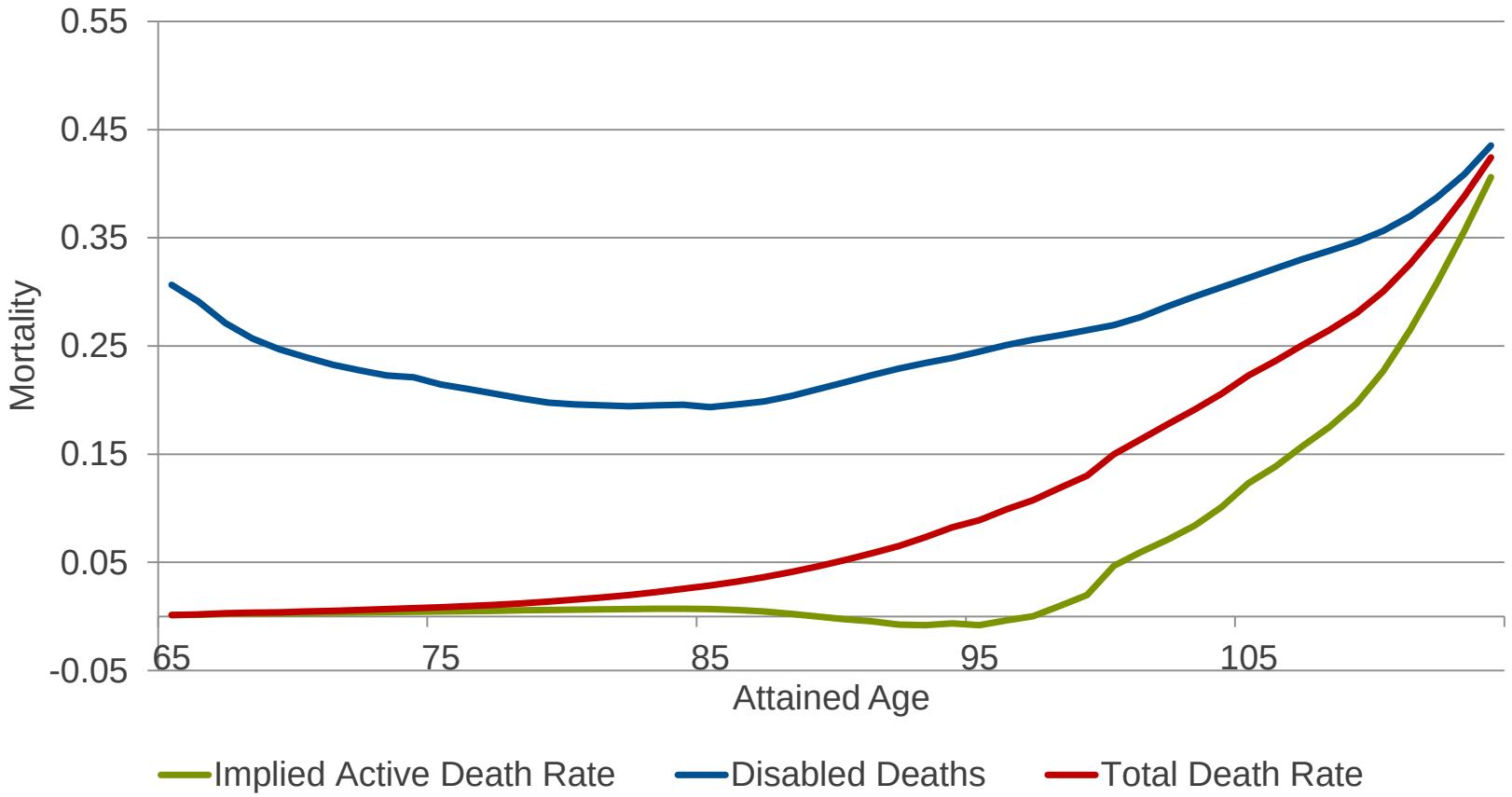


Care Path Modeling
Individual Care Path



Assumption Interaction

- Odd results if assumptions are set independently



Deterministic vs Stochastic

Deterministic

- Large arrays necessary to track hundreds of cohorts of disabled lives
- Separate “models” for account value, extension benefits
- Output is simple and tractable

Stochastic

- Model code is simple/straightforward
- Output is *very* data intensive
- Applications
  - Certain benefits easier to model
  - Understanding variability in results
  - Measuring tail risk

Why Build a Stochastic Model?

- Sounds Complicated!
- Alternative may be worse
- Simplify Modeling

How do I incorporate a random element?

- A single iteration within the model projects out one policy's life cycle
- Monthly policy status is determined by the random value generated

- If the policy is active, one of four things can then happen:

- If the policy is disabled, one of three things can then happen:

- Premiums are collected and benefits are paid dependent on policy status

What do I need to build a model like this?

- Modeling Software not needed
- Really good random number generator
  - C
    - Generates 32,768 different values
  - MERSENNE_TWISTER
    - Approximately 4.3 billion different values
    - Extremely long period ($2^{19937} - 1$)
    - Go to generator used in R, Python, MATLAB, Stata, SAS, and SPSS
- Ability to capture and analyze the data

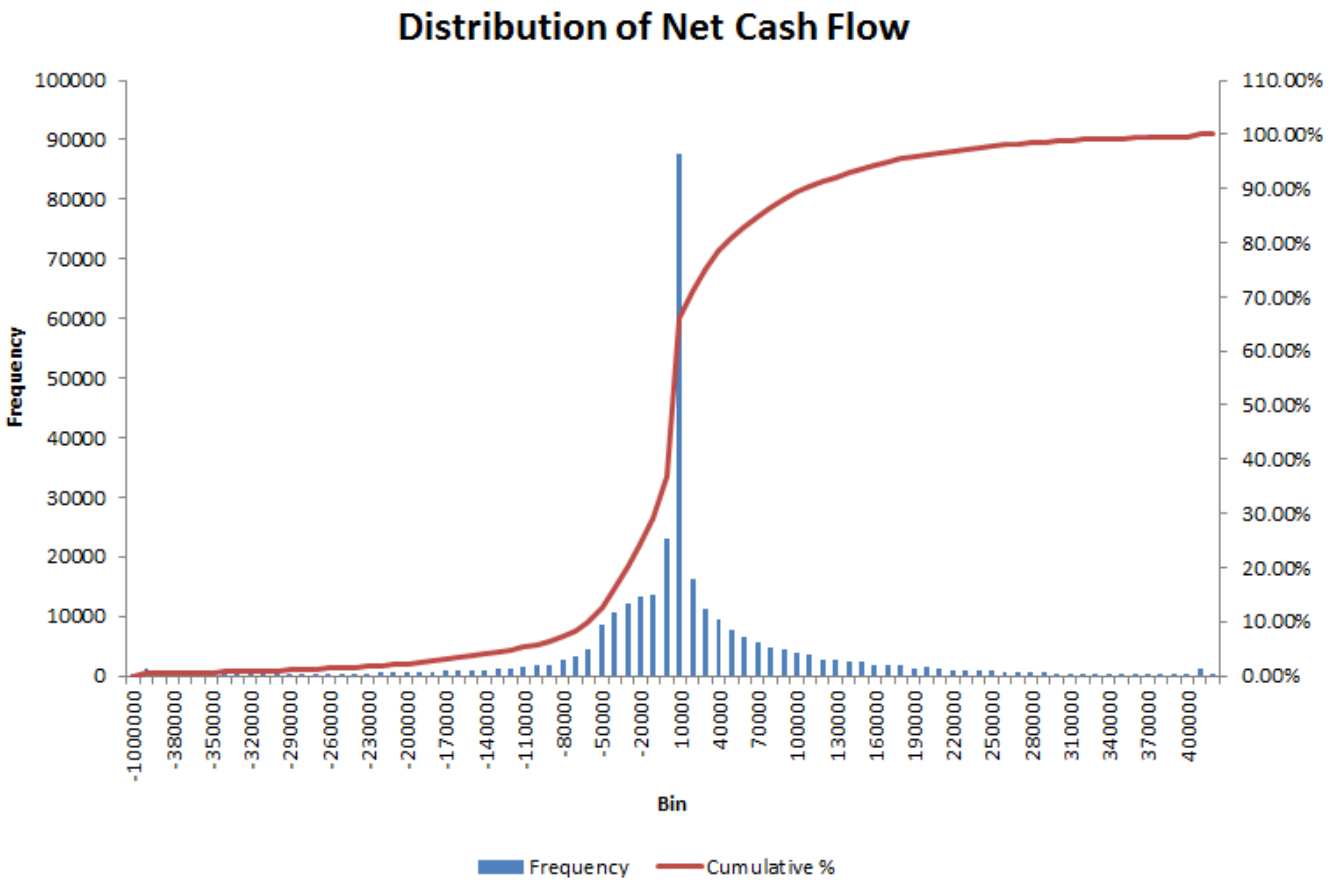
What can I do with the output?

- Assumption Validation
- Better Understand the Risks
- Price

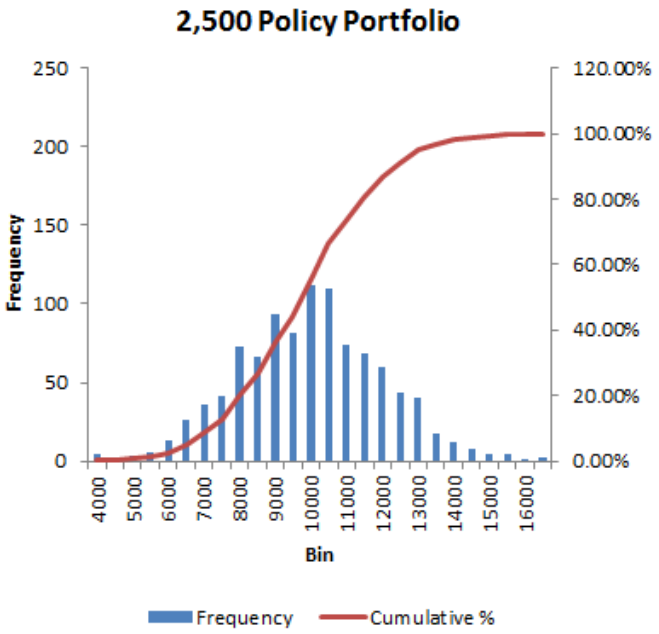
Assumption Validation

- Compare model output to industry averages
  - Average age at claim
  - Average time on claim
  - Percent of terminations from recovery
  - Largest / Longest claim
  - Care Site
  - Probability of using LTC claims
  - Probability of Exhaustion of Benefits
  - Probability of lapse
  - Expected utilization

Getting to know the tail

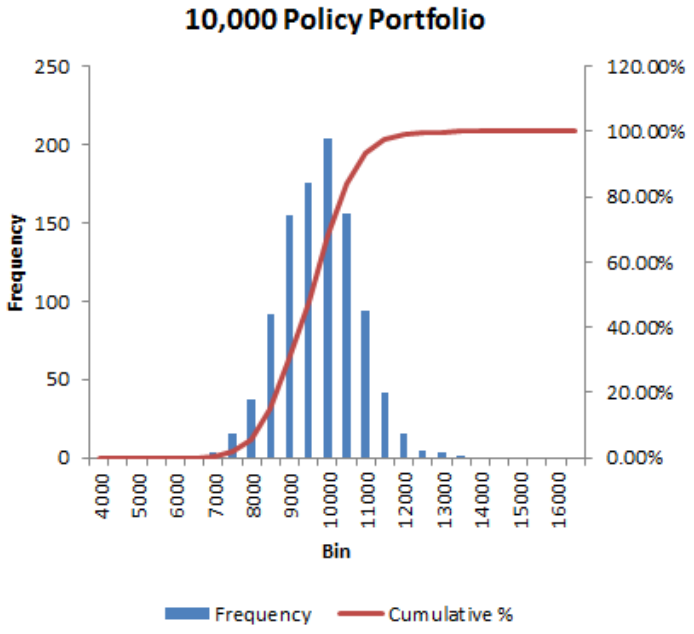


Building a Portfolio



Mean: $9,749

Std Dev: $2,020



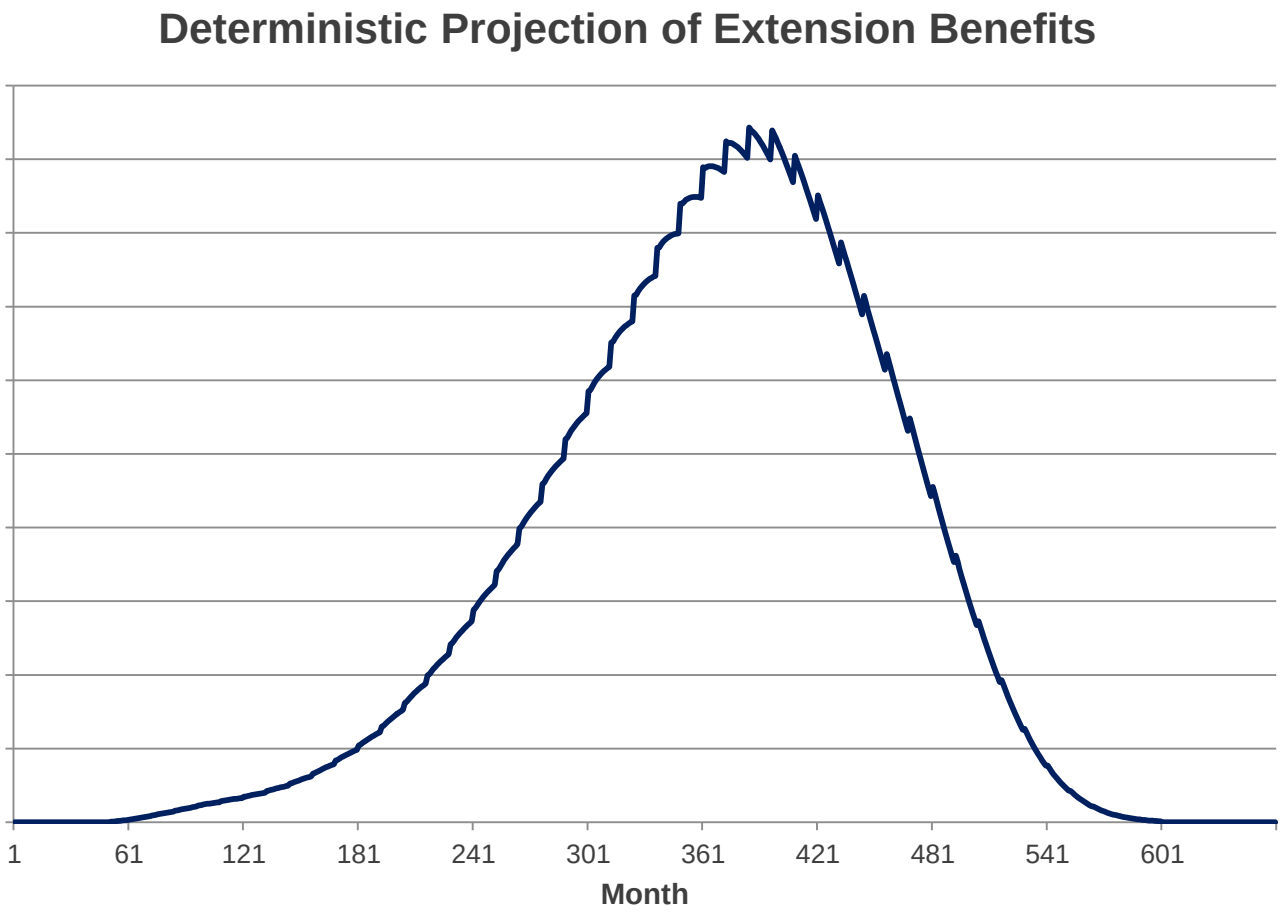
Mean: $9,539

Std Dev: $998

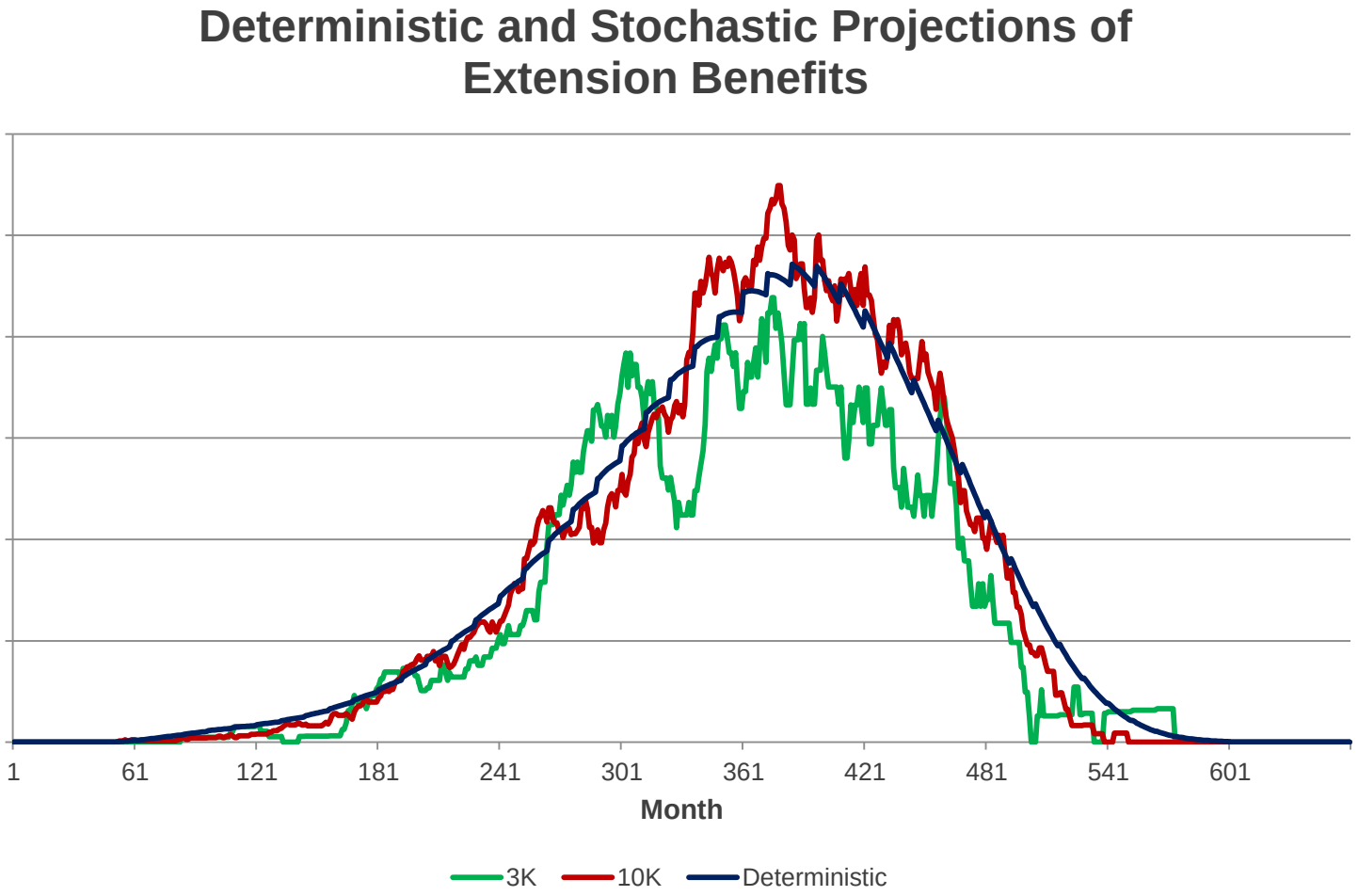
Pricing with the Stochastic Model

- Pricing can be challenging with stochastic output
- Need enough projections to feel confident in the level of benefits
- Mortality and Acceleration do not require as many iterations as the Extension rider
- What do you hand-off to your valuation area?

Pricing with the Stochastic Model



Pricing with the Stochastic Model



Taking it to the next level

- Move beyond best estimate assumption inputs to assumption that vary stochastically

- Test different scenarios
  - Mortality Slope
  - Pandemic
  - Advancements is chronic conditions
  - Lapse sensitivities