Practical Applications of Stochastic Modeling for Disability Insurance

Southeastern Actuaries Conference
Amelia Island, Florida
June 20, 2008

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Agenda

- Challenges in Modeling DI business
- Solution – A new DI Framework
- Implementation of the Framework – Stochastic DI model
- Stochastic DI models and Interest Rate Scenarios
- Uses of Stochastic models
- Sample results

Challenges in Modeling DI Business

- Complications in validating to short term financial results
  - Reporting lags
  - Timing of reserve changes and start of benefit payments
  - Reopens, settlements
- Number of combinations of product provisions (EP, BP, Benefit patterns, COLA types, Reinsurance, etc.)
  - Makes grouping into homogeneous model points difficult.

Solution – A New DI Framework

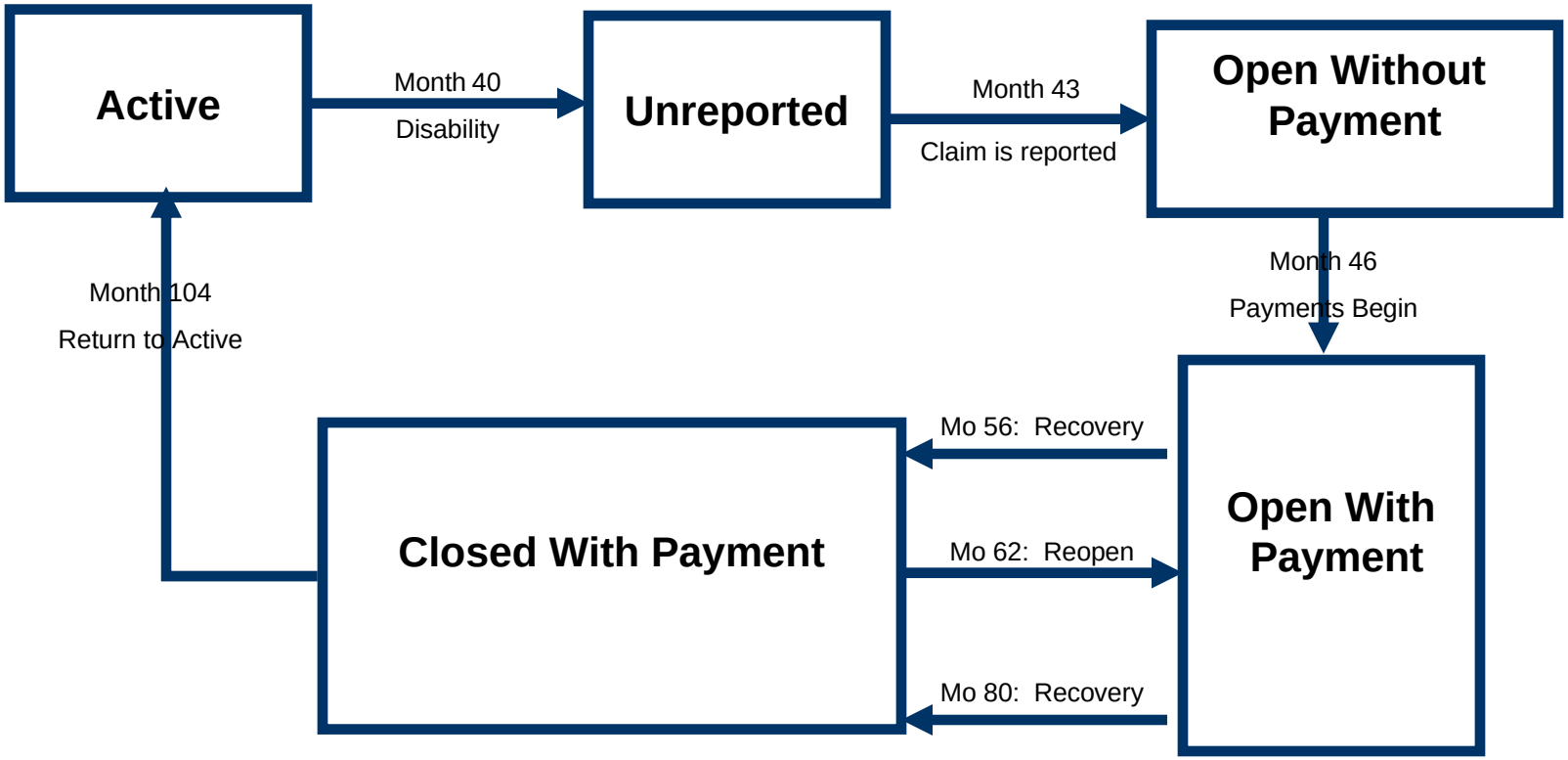
- Goals
  - Link experience analysis and models with financial and operational metrics.
  - Focus on the drivers of financial results.
- Result—Defined 7 Policy States
  - Active
  - Unreported claim
  - Open (without payment)
  - Open (with payment)
  - Closed (without payment)
  - Closed (with payment)
  - Termination (lapse, death, settlement, expiry)
- Policy movements among states

Policy Movements

From State	To State
Active	Active
	Lapsed
	Unreported (Disability)
	Death
	Expiry
Unreported	Unreported
	Closed without Payment
	Closed with Payment
	Open without Payment
	Open with Payment
Open without Payment	Open without Payment
	Closed without Payment
	Closed with Payment
	Open with Payment

From State	To State
Open with Payment	Open with Payment
	Closed with Payment
	Death
	Settlement
	BP expiry
Closed without Payment	Closed without Payment
	Closed with Payment
	Open without Payment
	Open with Payment
	Lapsed
	Unreported (Disability)
	Active
Closed with Payment	Closed with Payment
	Open with Payment
	Death
	Settlement
	Lapsed
	Unreported (Disability)
	Active

Policy Movements -- Example



Stochastic DI model

- Stochastic approach greatly simplifies implementation of the multi-state model.
- Mechanics
  - Movements are driven by random numbers.
    - Each month, a random number is generated and compared with the movement probabilities to determine what the policy does in that month. A policy may be in only one state in each month.
    - If a disability occurs in the month, two more random numbers are generated to determine the type of disability (total accident, total sickness, presumptive, residual, MNAD), and the reporting month.
    - Comparison to a deterministic model.
  - Multiple iterations (scenarios) are run, providing a distribution of results. The mean over all iterations provides a single "deterministic-like" value.

Stochastic DI model (cont.)

- Stochasticizing of morbidity assumptions
- Seriatim model
  - Handle each policy's characteristics (EP/BP/Benefit pattern/COLA/Reinsurance/etc.) directly rather than aggregating.
  - Avoids modeling effort and possible inaccuracy of groupings.
- Fast runtimes are possible
  - Calculations for a policy go down a single path.
  - Calculations stop when the policy terminates.
- Implications of this modeling approach for PBA
- Applicability to other products

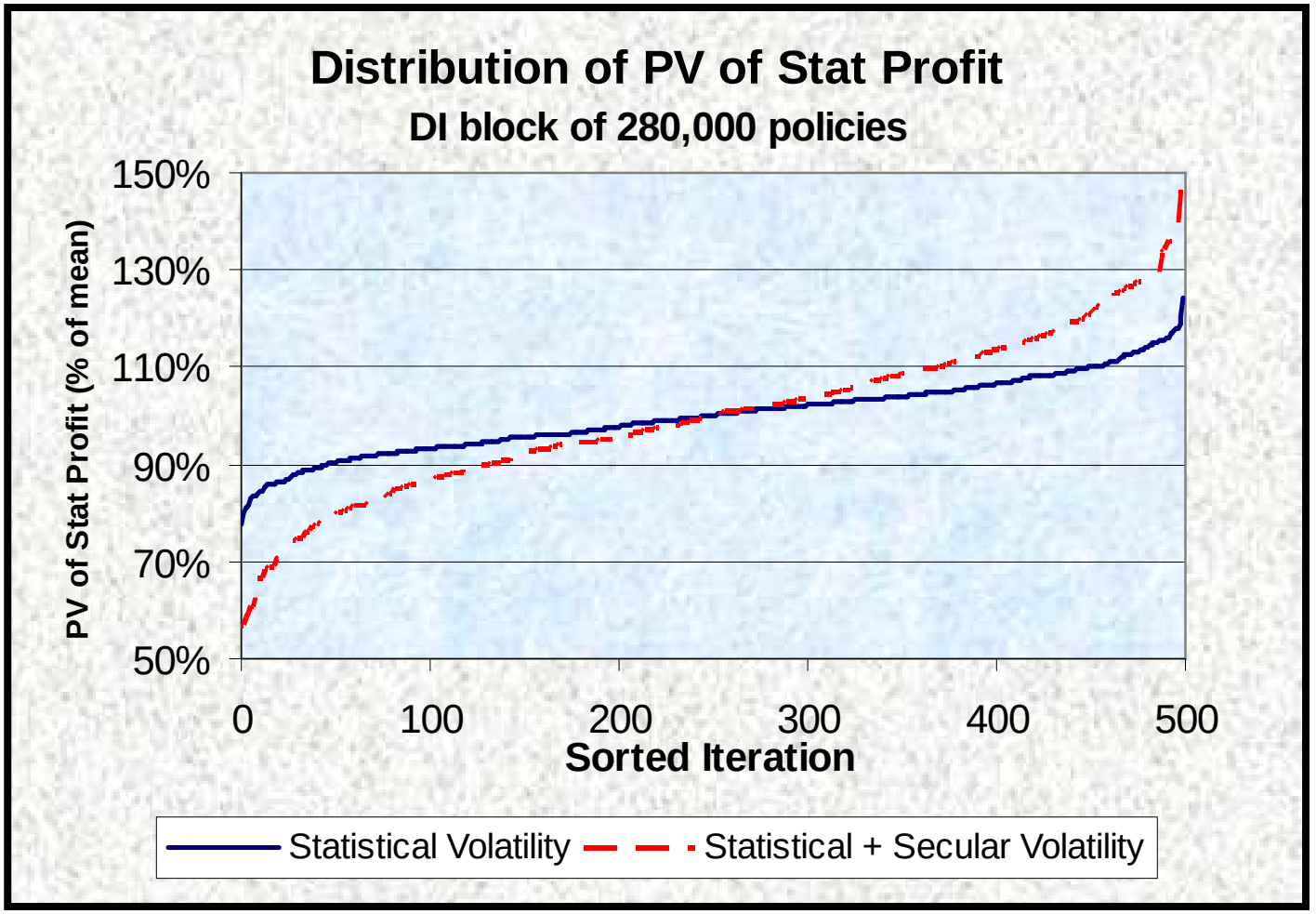
Stochastic DI models and Interest Rate Scenarios

- Linking to Interest Rate Scenarios
  - The volatility on the liability side adds to that coming from the asset side.
- Are DI liability cash flows interest-sensitive?
  - Expenses (inflation rate)
  - CPI-linked COLA
    - ALM Impact: Shortening of liability price-sensitivity duration.
  - Claim incidence and recovery? DI lapse rates?
  - LTD renewal pricing strategy
    - Dynamics can be similar to annuity crediting strategy.
    - Modeling future LTD premium and/or persistency as a function of interest rates gives strongly interest-sensitive CF's.

Uses of Stochastic Models

- Uses of mean (deterministic-like) projected values
  - CFT, RAS, Pricing, Financial Plan
- Uses of distributions of projected values
  - Analyzing recent experience and financials (Is it random fluctuation or a real shift?)
  - LTD Credibility
  - ALM
  - Valuing a block of business—Provides a depiction of the range of potential outcomes.
  - Principles-based reserves and capital levels
  - Stop-loss reinsurance
  - Risk Management, VaR

Sample Results



Sample Results