Actuarial & Finance

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The Dilemma with Mortality and Morbidity Trends

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Agenda

- Mortality Improvement Trends
- Morbidity Improvement Trends
- Accounting
- Predictive Analytic

Mortality Improvement

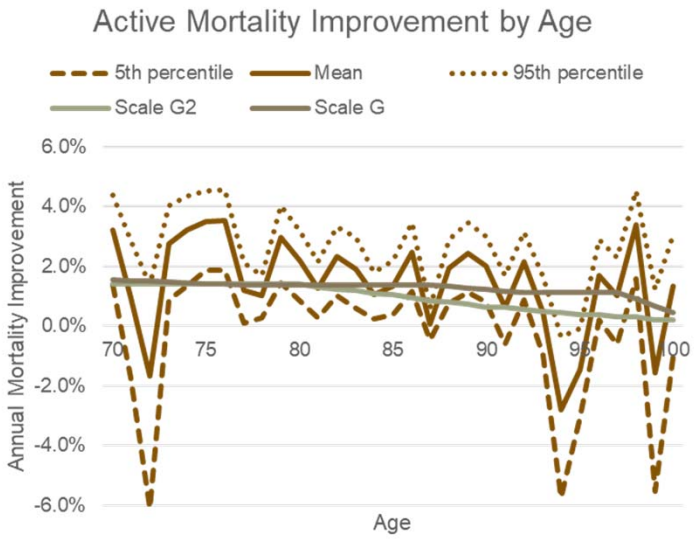
- Long Term Care Risk=longevity risk
  - Most individuals will need LTC services if they live long enough
- Mortality Improvement is one of the more significant risks
- Historical evidence is inconclusive if disabled mortality improvement has occurred in historical LTC data
- LTC actuaries have historically assumed:
  - Active Life Mortality Improvement will cease in 10-20 years
  - Disabled Life Mortality Improvement doesn't exist
- Since there is over 100 years of mortality improvement evidence in almost all populations of the US, should mortality improvement apply to the entire population (active, disabled, and future disabled)?

Mortality Improvement –Historical Application

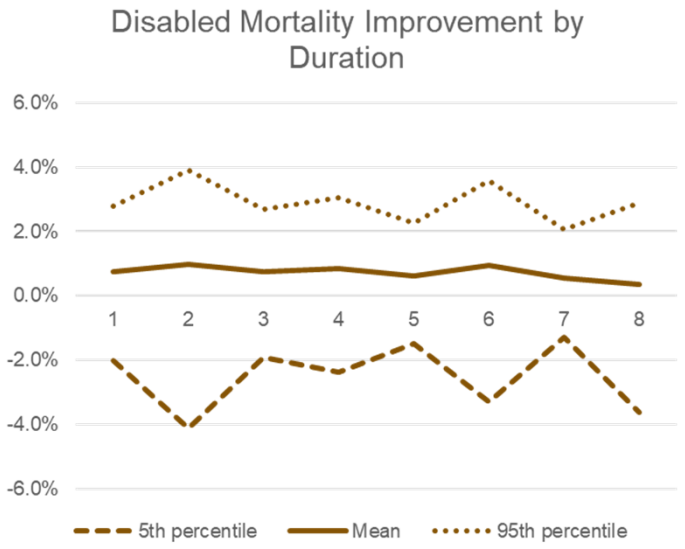
- Active live mortality improvement generally modeled as a geometric process
  - Same rate of improvement in each year of projection
- Difficult to observe in historical data
  - Level of mortality improvement is small compared to mortality rate
  - Is it just statistical variance?
  - Significant amount of data over an extended period of time is needed
- Analyzing a single book of LTC for a short time horizon (10 years) and observing no change in overall mortality levels is insufficient
  - Societal factor– not a function of underwriting or management
  - Lumpiness—more of a step function than a geometric process

Mortality Improvement Example

Active Lives



Disabled Lives



Notes: Simulated using a Lee-Carter model, calibrated on Industry data from 2001-2011 for active lives excluding active deaths for policies within 15 years of policy issue and 2006-2011 for disabled lives. The range assumes the parameters are "correct" and no parameter risk. For disabled lives, we are applying an age based stochastic longevity model to durational analysis**.** Excludes active deaths within 15 years of policy issue.

Mortality Improvement Sources

- Assumptions vary due to:
  - Projection scale selected
  - Time period selected for improvement
  - Population to which improvement is applied
- Sources include industry tables and company tables:
  - Mortality Improvement Scale G2
    - Projection scale for the 2012 Individual Annuity Reserving Table using Social Security Administration data
  - Company tables
    - Developed across all line of business
    - Consistent basis
- Typically a total lives basis
  - No consideration of disability trigger
  - 2019 OASDI Trustees Report indicates death rates for Disability Insurance Beneficiaries change at the same rate as the general population

Mortality Improvement – Background on G2

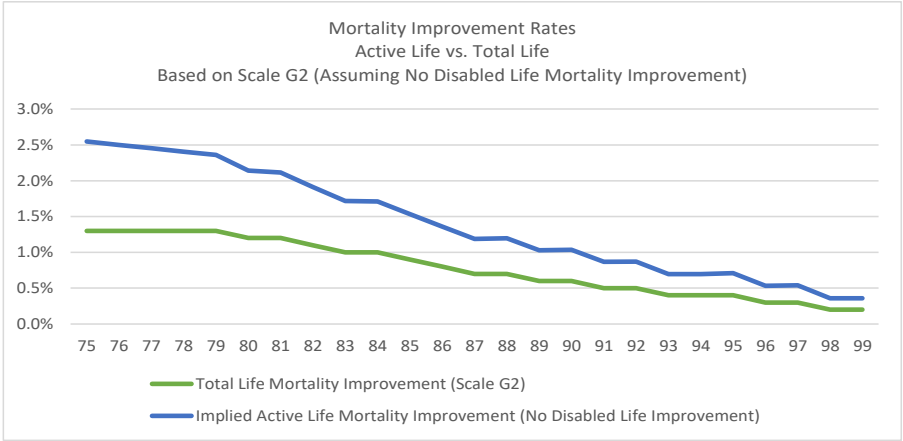
- Some background on Scale G2
  - Scale G2 is the mortality improvement table that underlies development of the IAM 2012 mortality table
  - IAM 2012 table reflects experience for annuities, annuitizations, and settlement options for life insurance (excludes substandard, structured settlements, and variable annuities).
  - Intended for use on a total life basis
  - IAM 2012 and Scale G2 are not directly based on LTC experience, but reflect some of the same attained age patterns
    - Grades off with age
    - Males show higher rates of improvement at younger ages

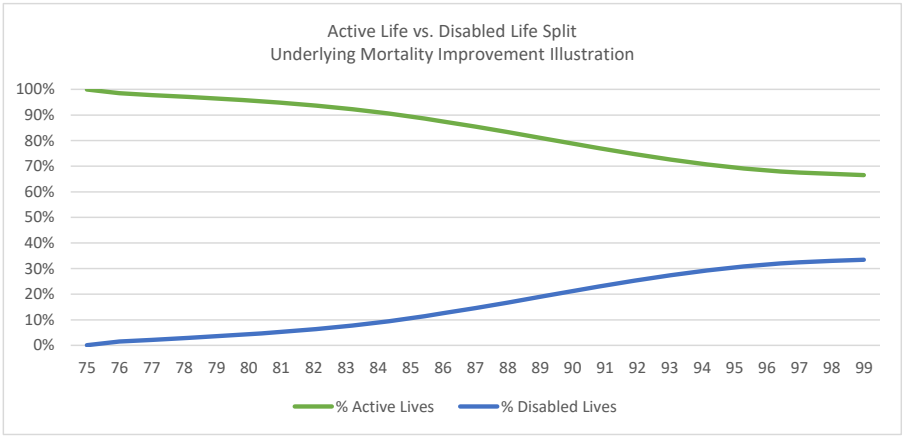
Scale G2 Mortality Improvement Illustrative Rates

Attained Age	Male	Female
70	1.5%	1.3%
75	1.5%	1.3%
80	1.5%	1.3%
85	1.1%	1.0%
90	0.7%	0.6%
95	0.4%	0.4%
100	0.2%	0.2%

Mortality Improvement – First Principles

- First Principles Considerations:
  - Scale G2 fits naturally with total life assumptions
  - Applying Scale G2 directly to active life mortality implies:
    1. Disabled life mortality improvement exists, and
    2. Disabled life mortality improvement is equal to active life improvement.
  - Graph displays implications for active life mortality improvement of assuming:
    1. Total life mortality improvement based on Scale G2;
    2. No disabled life mortality improvement;
    3. Uses representative morbidity assumptions applied to a single, age 75 female, not on claim at the valuation date.





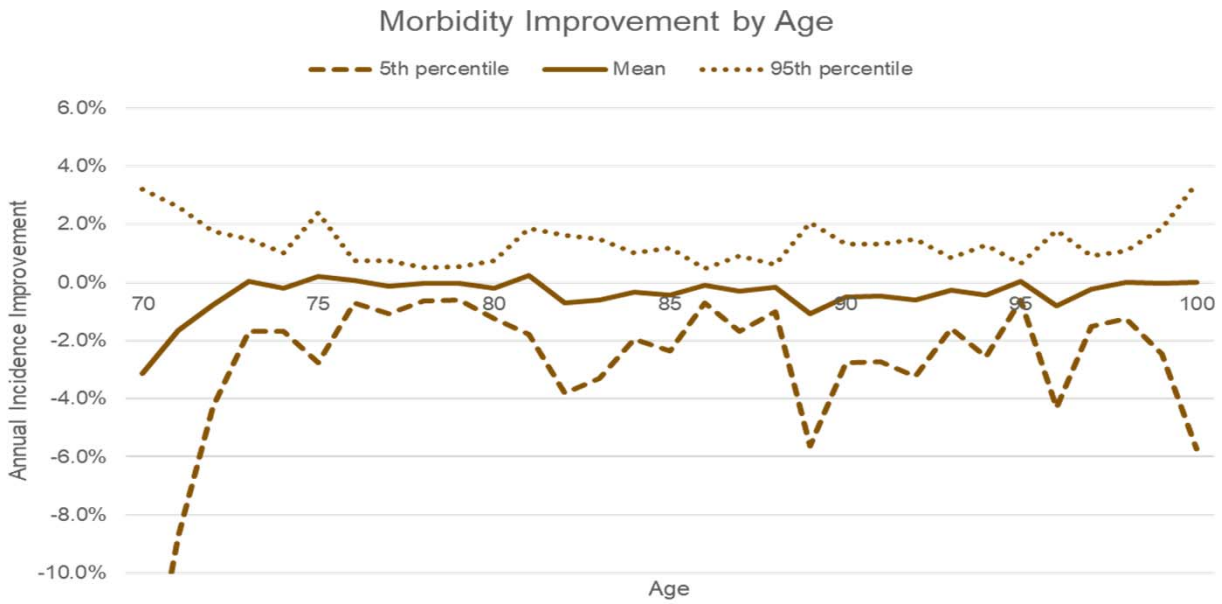
Morbidity Improvement

- Morbidity Improvement has meant incidence improvement
  - Assumes continuance is constant
  - Original population evidence is steady decline in disability rates in seniors
    - Must be mindful of potential dis-improvement in continuance
- LTC actuaries have historically assumed:
  - Morbidity improvement will cease in 5-20 years or hold the time period constant
  - Mortality improvement and morbidity improvement go hand-in-hand
    - Stronger and measured existence of mortality improvement
    - Living longer doesn't necessarily improve the rate of claim
- Morbidity could have dis-improvement due to the change in family unit

Morbidity Improvement –Historical Application

- Actuaries tend to model active life morbidity improvement as a log-normal process
  - Same rate of improvement occurring in each year of the projection
- Difficult to observe in historical data
  - Level of morbidity improvement is small compared to incidence rate
  - Is it just statistical variance or claims management?
  - Significant amount of data over an extended period of time is needed
- Historically LTC carriers have relied on population experience studies
- SOA Intercompany experience data (2000-2011) study was not able to conclusively support nor deny the existence of a trend in calendar year improvement
- Analyzing a single book of LTC is inconclusive
  - Societal factor– not a function of underwriting or management
  - Trends observed can be due to other factors
    - Change in mix of policyholders in an attained age cohort
  - It takes a tremendous amount of data to isolate and hold steady a constant cohort
- Ensure that the combined effect of the ultimate attained age assumptions by issue age group and the morbidity improvement assumption is reasonable

Example of Morbidity Improvement (2006-2011)



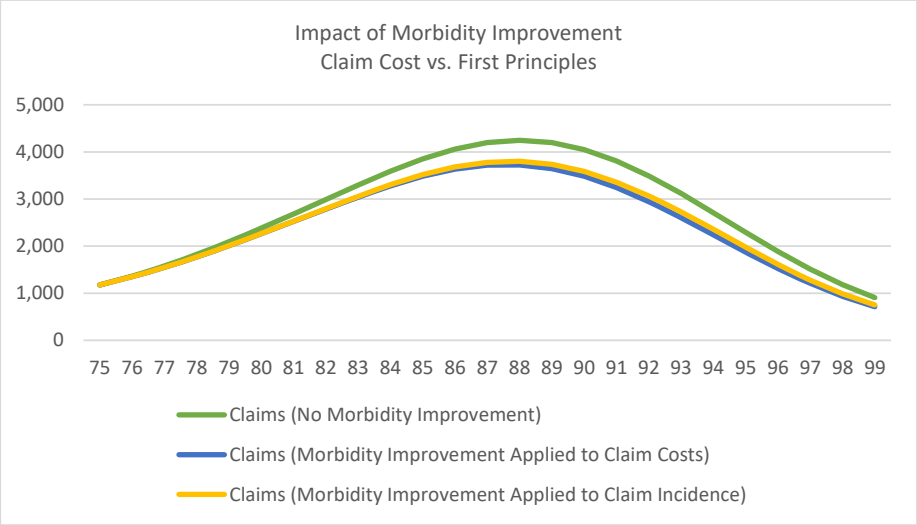
Notes:

- Simulated using a Lee-Carter model, calibrated on Industry data from 2006-2011.
- Excludes claims within 15 years of policy issue.
- The range assumes the parameters are "correct" and that there is no parameter risk.

It takes a lot of data to demonstrate morbidity improvement

Morbidity Improvement

- Items to consider:
  - Does improvement relate to claim incidence or claim severity?
  - For morbidity improvement, what is the exposure base? Active life or Disabled Life?
  - How should one think about consistency of morbidity improvement? Total life basis? Active life basis?
  - Does morbidity improvement in a claim cost model have the same interpretation as morbidity improvement in a first principles basis?
- Graph compares:
  - Applying 1% annual improvement to claim costs
  - Applying 1% annual improvement to claim incidence rates



Impact of Morbidity Improvement
Claim Cost vs. First Principles
Present Value (5%) on Claims

Approach	PV (5%)	Impact Relative to No Improvement
No Morbidity Improvement	37,592	
Morbidity Improvement Applied to Claim Costs	33,902	90.2%
Morbidity Improvement Applied to Claim Incidence	34,463	91.7%

Mortality Improvement Accounting

- Whether or not mortality improvement should be required in statutory reserves is a decision for the NAIC
  - State by state or carrier by carrier application results in different capital standards and lack of comparability
  - Conclusion that some carriers are exposed to mortality improvement while others are not based solely on the carrier's historical results is an incorrect understanding of societal risk
- Asset Adequacy Analysis
  - Not required
  - Prudent to run sensitivity test to understand impact
- Mortality improvement is a slow-moving process
  - Multi-line company should be able to fund these claims without necessarily posting the reserves today for this contingency—test impact
  - Monoline company should demonstrate it has adequate resources available for this contingency

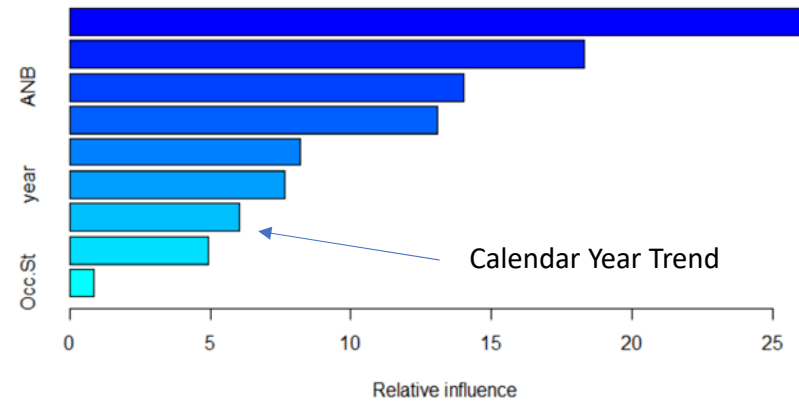
Morbidity Improvement Accounting

- Statutory contract reserves
  - Prohibit carriers from assuming morbidity improvement
- Asset Adequacy Analysis
  - Best estimate assumptions (with PAD)
    - Often includes morbidity improvement
  - Prudent to run sensitivity test to understand impact
- Morbidity improvement is a slow-moving process
  - Multi-line company should be able to fund the claims from no improvement without necessarily posting the reserves today for this contingency—test impact
  - Monoline company should demonstrate it has adequate resources available for this contingency
- Morbidity improvement is an example of booking a financial gain before you are released from risk
  - Recognizing morbidity improvement in reserves is similar to booking excess investment spread on day 1 rather than when it is earned
  - In financial world, you don't take credit for the higher reward until it is experienced

Using Predictive Models to Discern Trends

- Predictive models can be used to discern calendar year trends in mortality and morbidity
- Models to Consider:
  - Poisson Generalized Linear Model
  - Gradient Boosting Machine
- Outline of the general approach:
  - Generalized Linear Model:
    - Fit a model with all statistically significant variables excluding the calendar year trend
    - Add a calendar year trend and test for significant of that feature
    - Can test different levels of annual improvement
  - Gradient Boosting Machine:
    - Fit a model with all potential variables, including calendar year trend, allowing model to identify what is significant
    - SHAP analysis of calendar year trend

Illustrative GBM (Disabled Life Mortality)
Relative Influence Graph



Illustrative GBM Model
Disabled Life Mortality
Designed to Detect Presence of Calendar Year Trend

Feature	Relative Influence
Age	14.00233004
Situs	13.08345768
Duration	8.183581413
Policy Year	7.642592666
Calendar Year Trend	***6.038216242***
Gender	4.942066937
Occupancy State	0.850534801

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