Longevity Risk in Fair Valuing Level-Three Assets in Securitized Portfolios

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Level-Three Assets Pose Unique Valuation Challenges

1. Definition of L3 = Valuation based upon an unobserved future event – death of the insured or pensioner. (Assume no carrier defaults or currency risk.)
2. Remaining Risk – Accurate mortality prediction (life expectancy/slope of survival curve)
3. Until now, there has been no uniform framework for valuation to assure consistency and transparency.
   a. U.S. GAAP and IFRS are converging and requiring fair valuation.
      a. International Accounting Standards Board (IASB) IAS §540, §520
      b. AICPA / PCAOB Auditing Standards AU§328, 329
      c. Financial Accounting Standards Board (FASB) ASC§820.10
   b. SEC will ask Congress to declare life settlements to be securities.
4. Together the standards offer a framework for managers, auditors and actuaries valuing life settlement portfolios, related derivatives and reverse mortgages.

At Core – Accurate Life Expectancy is Key to Fair Value Measurement

Applying the Newest and Largest Tables Don't Help

1. Large population-based mortality tables, since Gompertz (1825), are known to be flawed. Iachine et al.

2. Law of Large Numbers (LLN) stochastic techniques are known to have significant standard deviations (errors). Milevsky

3. The latest insurance industry tables, VBT 2008, are largely extrapolated data past age 75.

Specific to Life Settlement Portfolios, Additional Variables Come into Play

1. Commercial life expectancy (LEs) providers, all looking at the same insured's medical records arrive at significantly different results. Results when there were three or more LEs:
   a. For post-2008 LEs, 31% difference between the High LE and the Low LE.
   b. Where the average difference is > 30%, the difference (Δ) is 56%.
2. Portfolios lack homogeneous policy sizes.
3. Portfolios seldom have sufficient policies to achieve satisfactory confidence levels (Longley-Cook 1962).

Policies Required for Credible Estimates

Credibility and Event Counts			
	Probability of Observed Count Falling Within the Acceptable Range		
Maximum Acceptable Departure from the Expected Count	90%	95%	99%
	Minimum Required Expected Count		
ı/-2.5%	4,329	6,146	**10,616**
+/-5.0%	**1,082**	**1,537**	2,654
+/-7.5%	481	683	1,180
+/-10%	271	**384**	663
+/-20%	68	96	166
+/-30%	30	43	74
+/-40%	17	24	41
+/-50%	**11**	15	27

Source: Based on Longley-Cook (1962)

Combined, these Factors Calls for New Valuation Methodology

1. Use survival functions from three independent life expectancy providers.
2. Include the Longevity Cost Calculator survival functions developed at policy selection.
3. Assume all have equal weighting at portfolio creation.
4. Quarterly / Annually perform actual-to-expected comparison for each vendor.
5. Apply Bayesian inference to establish new weighted average portfolio valuation.
6. Apply Monte Carlo or other stress tests on cash flow.
7. Document, publish and repeat.

Origins of LSF's Longevity Cost Calculator Methodology

The LCC is based on the National Long Term Care Surveys of 1984-1999.

95 variables were analyzed including medical conditions, functional and cognitive impairments, range of motion and behavioral characteristics.

32,000 individuals were assessed at random resulting in over 20,000 deaths.

The analysis was peer reviewed and published in the *North American Actuarial Journal* in 2007.

The model's author, P.J. Eric Stallard, was the recipient of the Edward A. Lew Society of Actuaries award in 2008 for his work in modeling chronic disability / LTC in seniors.

Model in use since 2006 as Long-Term Care Planning Tool on Medicare.gov web site.

Components of the LCC Questionnaire

- Medical conditions
- Medical conditions past 12 months
- Subjective health status
- Habits/behaviors
- Height, weight, BMI
- Activities of Daily Living (ADL)
- Instrumental Activities of Daily Living (IADL)
- Range of Motion
- Short Portable Mental Status Questionnaire (SPMSQ)
- Proxy respondent

Top 20 Elements Ranked by Chi-Square/d.f.

1. IADL Limitations-Outside mobility
2. IADL Limitations-Grocery shopping
3. IADL Limitations-Travel
4. IADL Limitations-Laundry
5. 5 year survival status
6. IADL Limitations-Cooking
7. Residence type: Institutional vs. noninstitutional
8. IADL Limitations-Light housework
9. IADL Limitations-Managing money
10. IADL Limitations-Taking medications
11. IADL Limitations-Phoning
12. ADL Personal Assistance Level-Bathing
13. ADL Personal Assistance Level-Indoor mobility
14. ADL Personal Assistance Level-Continence
15. Race
16. ADL Personal Assistance Level-Transferring in/out of bed
17. Proxy interview
18. ADL Personal Assistance Level-Dressing
19. ADL Personal Assistance Level-Toileting
20. **Medical-Circulation trouble in arms or leg, previous 12 months**

Key Predictor:
Grade of Membership (GoM) Scoring

Allows large numbers of variables to be simultaneously analyzed and is an essential building block for defining covariate trajectories.

Generates scores for each individual person included in the analytic data set representing that person's declining vitality.

GoM I – Generally healthy with lowest level of impairments

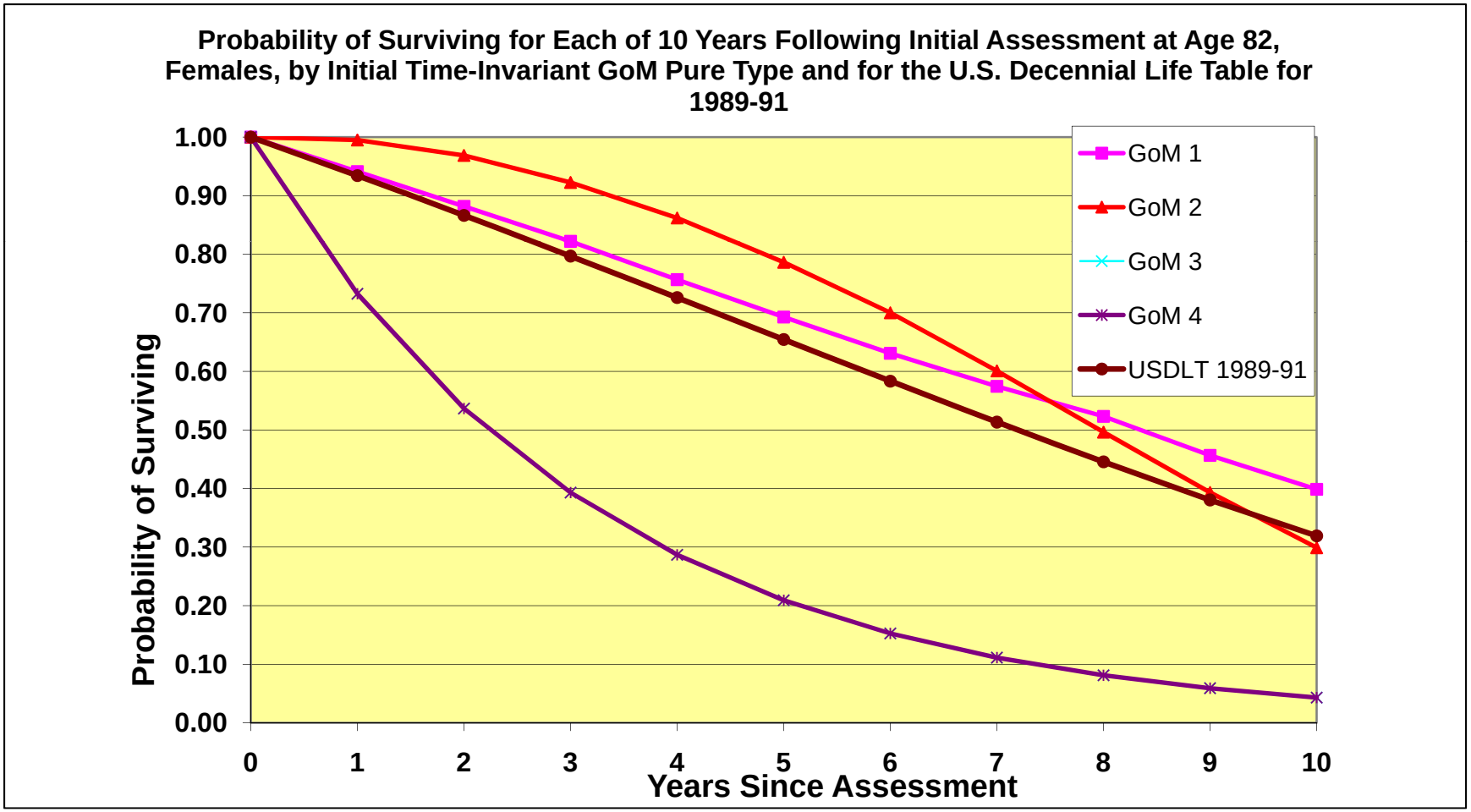
GoM II – Poorest subjective health, largest number of medical conditions, non-institutionalized, low mortality

GoM III – High mortality rates, few medical conditions, few impairments relatively good subjective health

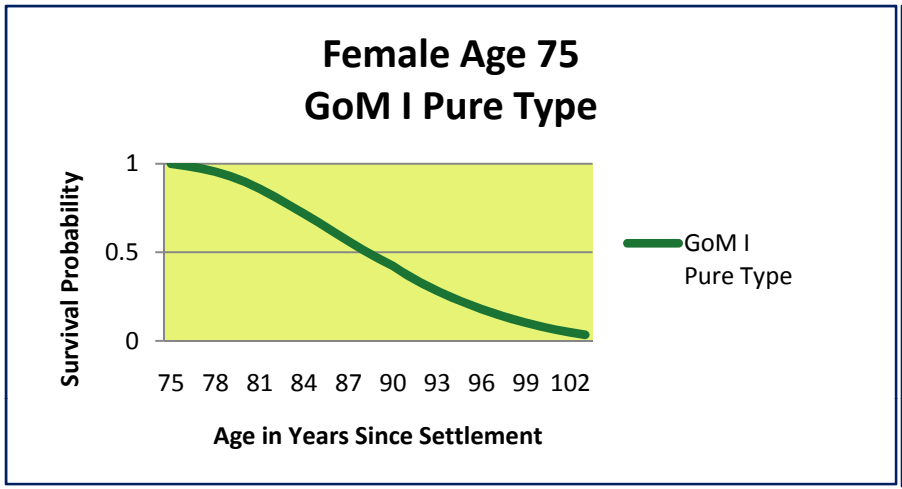
GoM IV – High mortality rates, high levels of physical and cognitive disability and institutionalization

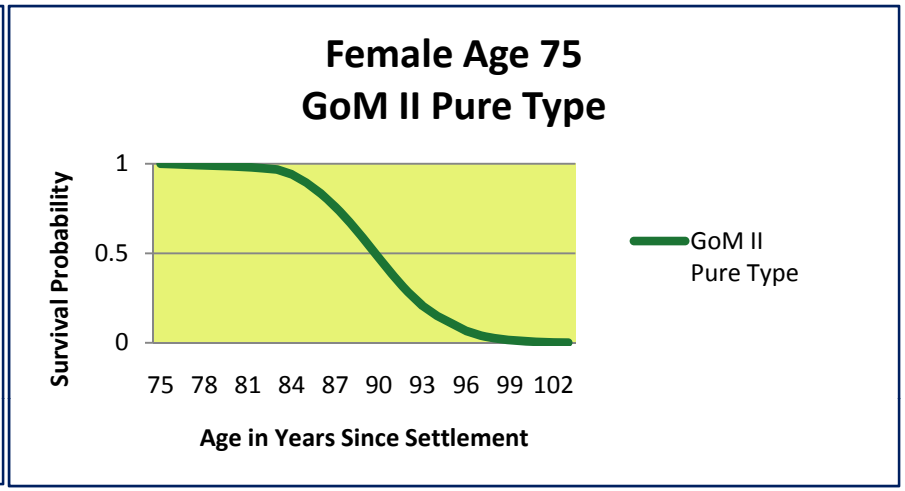
Comparable Trajectories of GoM Pure Types

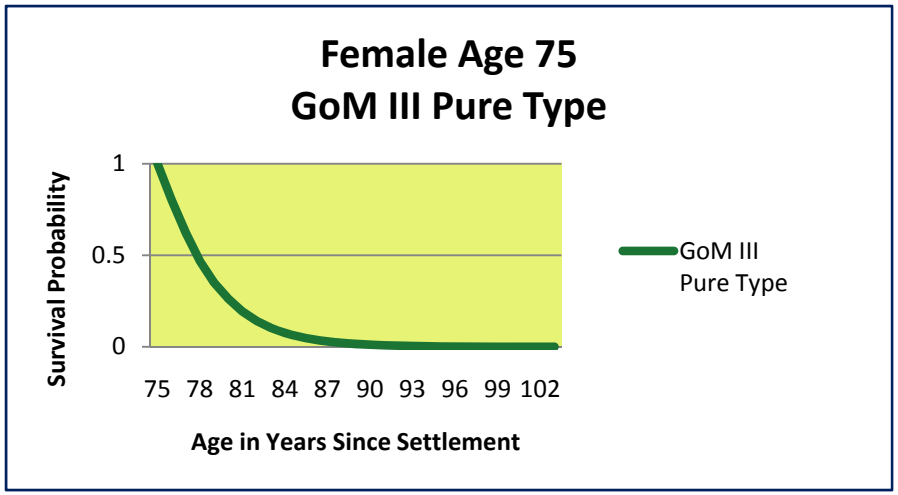
(at Age 82, GoM III and GoM IV Have Converged)

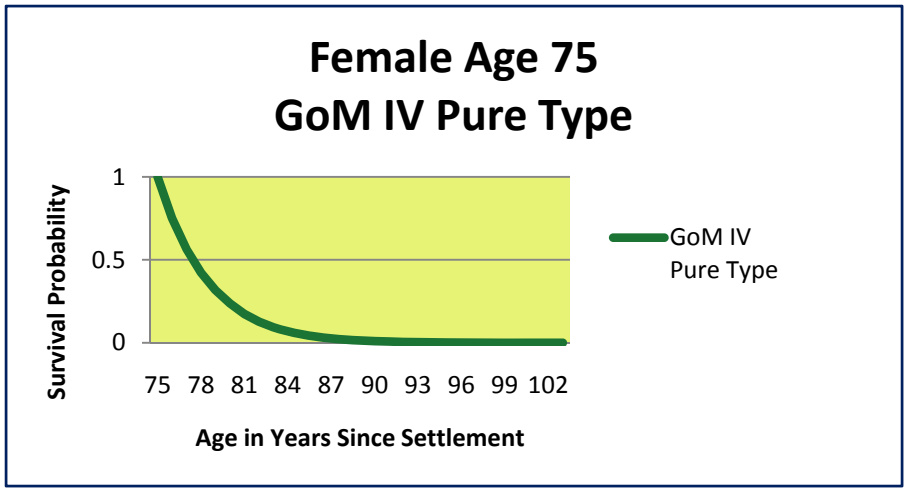


Comparative Trajectories of GoM Pure Types









(Area Under the Line is Life Expectancy at Time of Settlement)

Longevity Cost Calculator
Actual vs Expected Results, by Age

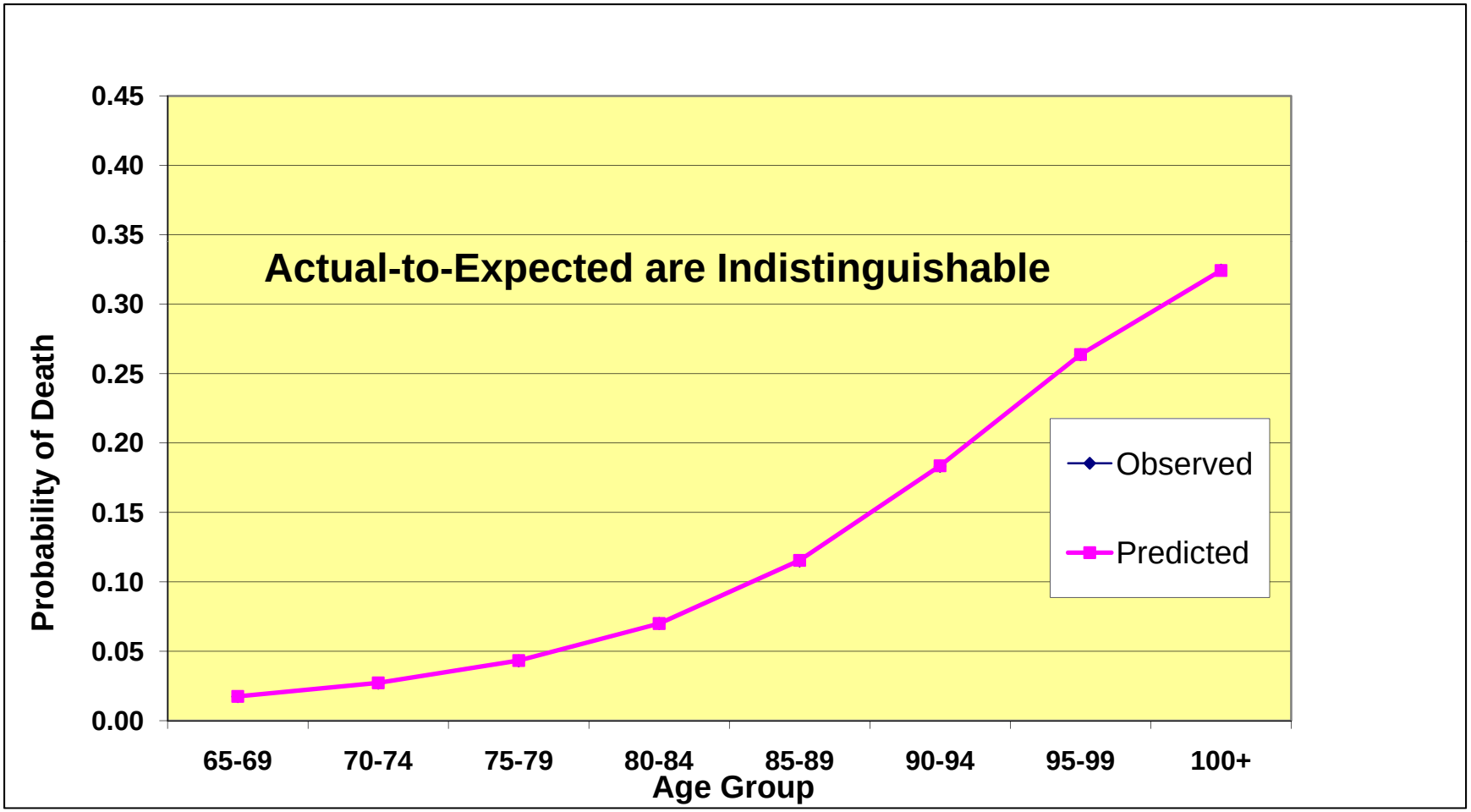
Probabilities of Death within One Year in Four Pure Types GoM Models, Adjusted for Declines in Vitality, by Sex and Attained Age at Time of Exposure

Exposure Age	No. of Person-Years at Risk[1]	Annual Probability by Type I	II	III	IV	Observed Probability	Predicted Probability
Males							
65-69	20,323	0.000	0.000	0.132	0.138	0.031	0.032
70-74	38,255	0.002	0.005	0.194	0.246	0.043	0.044
75-79	31,291	0.038	0.013	0.319	0.319	0.067	0.067
80-84	19,170	0.095	0.023	0.340	0.340	0.105	0.106
85-89	8,117	0.127	0.202	0.330	0.330	0.154	0.155
90-94	2,728	0.198	0.323	0.323	0.032	0.228	0.229
95-99	793	0.226	0.434	0.434	0.434	0.301	0.301
100-104	155	0.372	0.528	0.528	0.528	0.400	0.401
Total	120,832	0.041	0.033	0.253	0.271	0.071 ⟷	0.072
Females							
65-69	25,424	0.000	0.000	0.081	0.140	0.017	0.017
70-74	52,008	0.001	0.003	0.108	0.223	0.027	0.003
75-79	48,498	0.018	0.003	0.249	0.249	0.043	0.043
80-84	35,563	0.059	0.005	0.267	0.267	0.070	0.070
85-89	20,404	0.089	0.110	0.271	0.271	0.115	0.115
90-94	9,577	0.127	0.272	0.272	0.272	0.183	0.184
95-99	3,804	0.168	0.388	0.388	0.388	0.264	0.264
100-104	992	0.274	0.499	0.499	0.499	0.325	0.324
Total	196,270	0.036	0.037	0.201	0.239	0.060 ⟷	0.061

[1] Includes up to four observations per respondent; excludes respondents age 65-69 in 1999.

Source: Stallard, NAAJ, 2007.

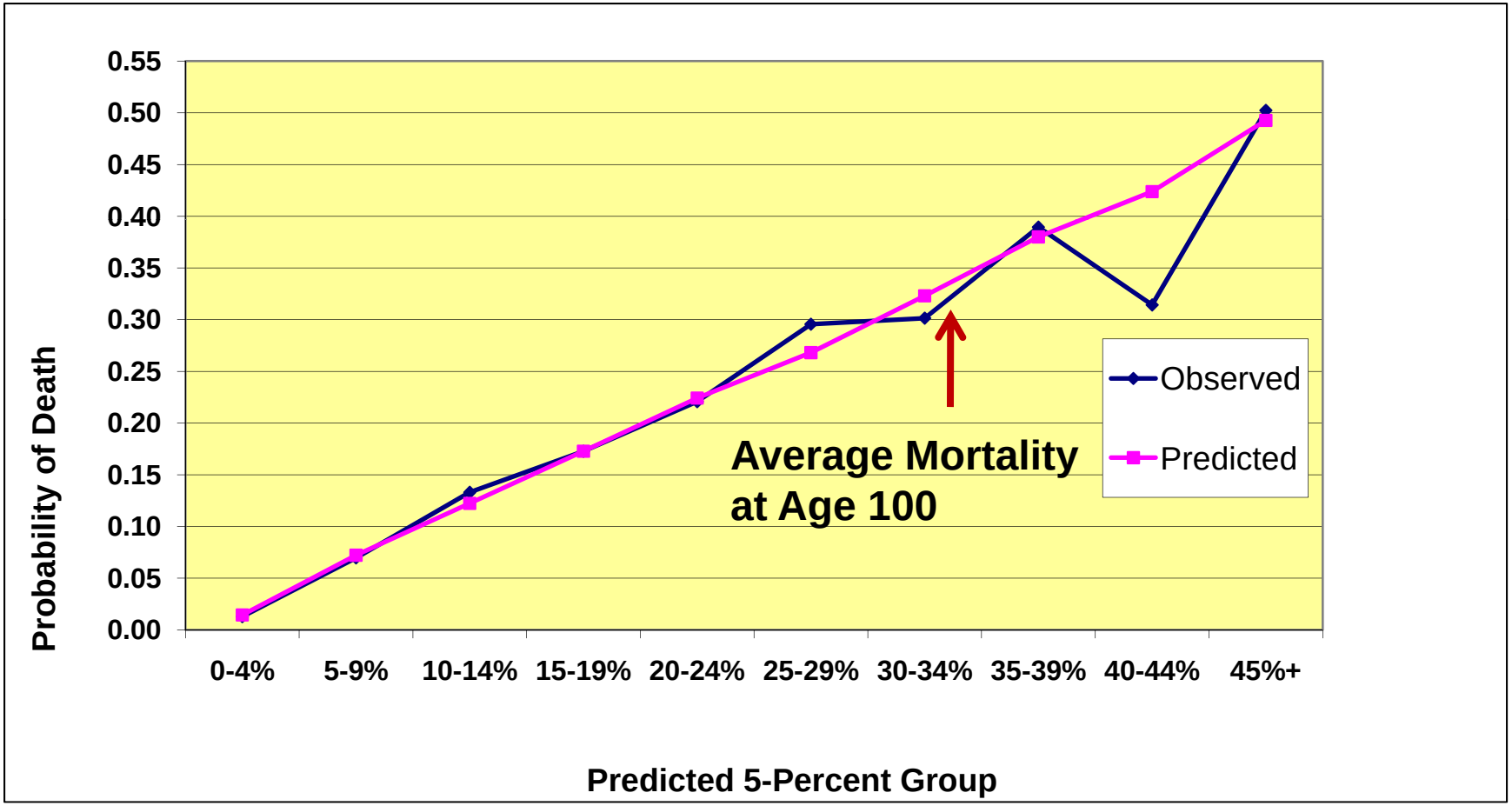
Observed and Predicted Probabilities of Death, Females, by 5-Year Age Groups



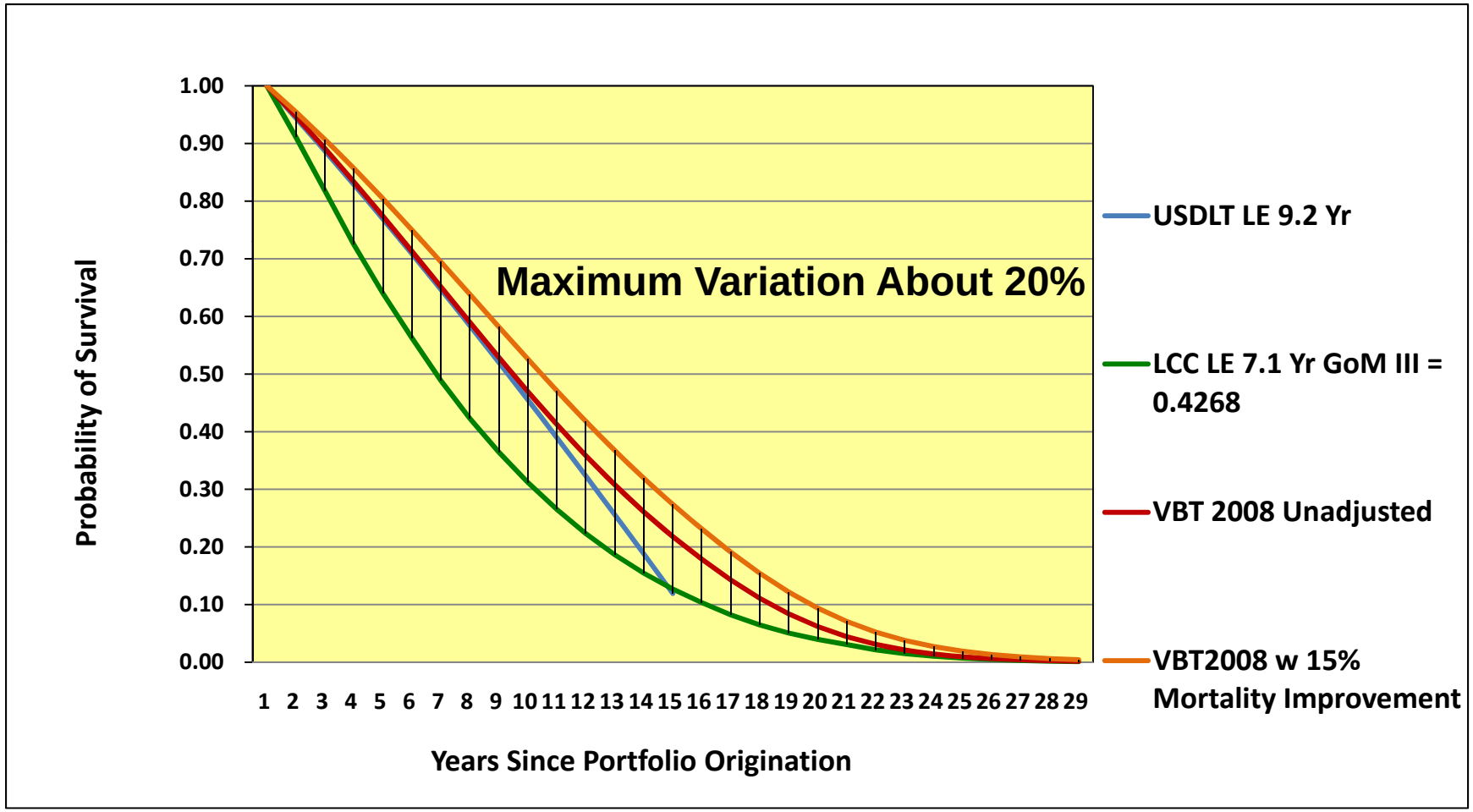
Log-Likelihood-Ratios for Four Sex-Specific Models with Corresponding AIC and BIC Statistics Used for Model Assessment (ΔBIC > 10 => Strong Evidence for Model with Lower BIC)

# Model Description	Log-Likelihood-Ratio	d.f.	AIC	BIC	ΔAIC	ΔBIC
			Males			
1. Constant Probability	0.00	1	2.00	9.06	10,878.66	10,659.87
2. Age-Specific Probability (no GoM)	1,632.10	8	-3,248.19	-3,191.73	7,628.46	7,459.08
3. GoM-Specific Probabilities (no Age)	5,278.87	4	-10,549.75	-10,521.52	326.91	129.30
4. Age & GoM-Specific Probabilities	5,470.33	32	-10,876.66	-10,650.82	0.00	0.00
			Females			
1. Constant Probability	0.00	1	2.00	9.38	16,276.04	16,047.27
2. Age-Specific Probability (no GoM)	3,776.30	8	-7,536.59	-7,477.56	8,737.45	8,560.34
3. GoM-Specific Probabilities (no Age)	7,873.29	4	-15,738.58	-15,709.06	535.46	328.83
4. Age & GoM-Specific Probabilities	8,169.02	32	-16,274.04	-16,037.89	0.00	0.00

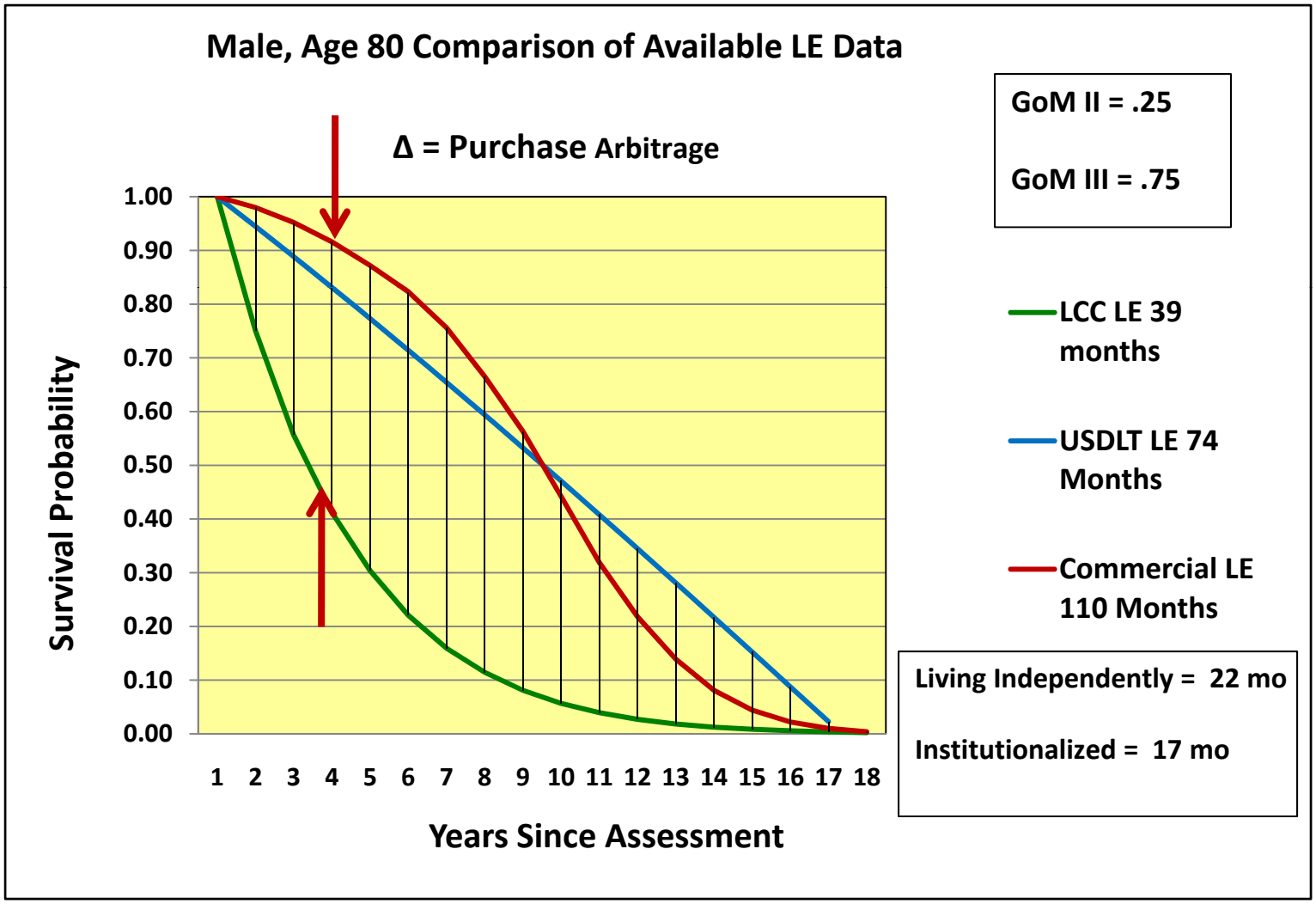
Observed and Predicted Probability of Death, Females, by Predicted Class Intervals with Cut-Points at Multiples of 5%



Comparable Life Expectancies Used in the Following Example



However, We Often See These Variations Between Medical Records Assessment and LCC



Valuation Methodology

1. Four LEs/Survival Functions for Each Insured in the Portfolio
   a. Offers are priced off each commercial LE and then averaged
   b. Priced using survival functions with MAPS 9.3.2
2. Hypothesis - Year 1 – assume each equal weighting

   0.25 to each x 4 = 1.0000
3. Evaluate Actual-to-Expected for Each LE provider for All Policies (insureds) at End of the Period
4. Establish new evidence of Actual-to-Expected
5. Apply Bayesian Inference to new factors to get Posterior Probability.
6. Use new weighted values x NPV of portfolio to determine new fair value.

The Reason to Get the LE Right and the Portfolio Value Correct

Facts:

1. 1,000 small face policies at $500,000 = $500,000,000
2. Average life expectancy 9.2 years
3. NPV @ 2% of portfolio value end of year 1 based upon each LE Provider's survival functions:

LE 1:	$329,00,000
LE 2:	$316,00,000
LE 3:	$274,00,000
LE 4:	$255,00,000

Difference between High & Low: $ 74,000,000 or 22.5% Δ

Portfolio Valuation – Actual to Expected Analysis by LE Provider by Period

Same Analysis Performed for Each LE Provider

	EXPECTED SURVIVAL AND DEATHS						ACTUAL SURVIVAL AND DEATHS					
	Expected Survival			Expected Deaths			Actual Survival			Actual Deaths		
Portfolio Member Code	Year-End 1	Year-End 2	Year-End 3	Year-End 1	Year-End 2	Year-End 3	Year-End 1	Year-End 2	Year-End 3	Year-End 1	Year-End 2	Year-End 3
0001-F	0.9577	0.9095	0.8564	0.0423	0.0905	0.1436	1.0000			0.0000		
0002-F	0.7824	0.6428	0.4987	0.2176	0.3572	0.5013	1.0000			0.0000		
0003-F	0.8974	0.8021	0.7895	0.1026	0.1979	0.2105	1.0000			0.0000		
0004-F	0.8547	0.7952	0.6587	0.1453	0.2048	0.3413	1.0000			0.0000		
⎮	⎮	⎮	⎮	⎮	⎮	⎮	⎮	⎮	⎮	⎮	⎮	⎮
1000-F	0.9211	0.9033	0.8524	0.0789	0.0967	0.1476	1.0000			0.0000		
Totals	883	811	731	117	189	269	852			148	Actual	
Less Expected Deaths										117	Expected	

Apply Bayesian Inference to Establish Weighted Average Value of Portfolio Cash Flows

At Portfolio Origination

LE Provider	NPV of Cash Flows Value	Assumed Probability	Probable Weighted Cash Flows	Probable NPV of Cash Flows
1	$329 Million	25%	$82.3 Million +	
2	$316 Million	25%	$79.0 Million +	
3	$274 Million	25%	$68.5 Million +	
4	$255 Million	25%	$63.8 Million =	$293.6 Million

Results Oriented Weighting at Subsequent Valuation, Year-End One

LE Provider	NPV of Initial Cash Flows	Derived Probability	Probable Weighted Cash Flows	Probable NPV of Cash Flows
1	$329 Million	42%	$138.2 Million +	
2	$316 Million	16%	$50.6 Million +	
3	$274 Million	28%	$76.7 Million +	
4	$255 Million	14%	$35.7 Million =	$301.2 Million

Conclusion

- Proposed fair value methodology is:
  - Credible
  - Compliant with accounting and audit standards
  - Easily implemented and documented by management
  - Can be consistently applied year-after-year
- As portfolio value improves it adds income.
- If value declines – consistent application of this methodology will avoid lags in portfolio write downs.
- Let us avoid knowingly repeating 2007-2009.