

# ***Universal Life Work Group***

## **Initial Modeling Results**

*provided to the*

***NAIC Life and Health Actuarial Task Force***

***September 2005***

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# Universal Life Work Group Initial Modeling Results

To the  
**Life and Health Actuarial Task Force**

**September, 2005**  
**New Orleans, LA**



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# Objectives for today's discussion

- Operation of the proposed methodology
- Aggregate quantification of margins that have been applied to all assumptions
  - Mortality
  - Interest Rates
  - Persistency (lapse/withdrawal)
  - Premium patterns
- Comparison of deterministic and stochastic reserve levels
- Comparison of proposed reserve to current formulaic reserve levels



# Operation of the Proposed Methodology



# Gross Premium Valuation (GPV) Reserves

- Present value of future benefits and expenses less present value of future premiums
- $GPV = \sum CF_t \times Disc_t$  over all t

WHERE

t = projection interval (annual, monthly, etc)

$CF_t = Benefits_t + All\ Expenses_t (excluding\ FIT) - Premium_t$

$Disc_t =$  discount factor to apply to cash flow in interval

- CF's exclude federal income taxes. Investment income is reflected in the discount rate and does not need to be included as an explicit item in the CF's.



# Gross Premium Valuation (GPV) Reserves

- $Disc_t$  recognizes the timing of the cash flow item within the projection interval
  - Beginning of interval, end of interval, or mid-interval
- $Disc_t = Disc_{t-1} / (1+i_t)^{1/(\# \text{ of projection intervals within a year})}$
- $i_t$  is a path of portfolio rates
  - Valuation is consistent between assets and liabilities (using book value of portfolio rates)
- Discount rates are pre-tax and net of asset defaults and investment expenses
- We have assumed monthly intervals in our model



# Proposed Reserve Methodology

1. **Reserve held will be the greater of:**
  - A deterministic, seriatim single scenario reserve calculation
  - A stochastically derived reserve (if needed) using a prescribed CTE level.
2. **Deterministic reserve** will use a single set of assumptions that is aligned with economic reality, yet still provide an appropriate level of conservatism. The Reserve is subject to a cash surrender value floor on an individual contract basis.
3. **Stochastic reserve** will be calculated using multiple scenarios to properly capture the “tail risk” for assumptions that involve a high level of optionality.



# Products Included in this Version of the Model

- Specified premium UL contract only
- This specified premium UL product is representative of a typical product that can be found in the marketplace
- Providing results for 2 individual cells (issue ages 45 and 75)
- Shadow Fund UL and 20 year term products will be included in the upcoming months



# Components of GPV Reserves

Specified Premium, Issue Age 45, Male Best class, \$1M face

	Item	Proposed Reserve	Current Reserve
(1)	Death Benefits	X	X
(2)	Expenses/Commissions	X	
(3)	Surrender Benefits	X	
(4)	Premiums	X	X
	GPV Reserve: (1)+(2)+(3)-(4)		



# Aggregate quantification of margins that have been applied to all assumptions



# Margins are applied for risks inherent in the products

- Mortality Risk
- Interest Rate Risk
- Persistency Risk
- Premium Pattern Risk



**Numeric Summary - impact of all margins on deterministic reserve**  
**Specified Premium Issue Age 45, Male Best class, \$1M face**

Policy Duration	Deterministic Reserve			
	No Margins on assumptions	Margins on all assumptions	Dollar Margin impact	% Increase
1	79	25,700	25,621	32364.5%
2	299	35,316	35,017	11714.5%
3	4,079	45,569	41,489	1017.1%
4	12,623	56,435	43,812	347.1%
5	21,946	67,841	45,895	209.1%
10	75,563	131,185	55,622	73.6%
20	223,591	287,534	63,943	28.6%
30	423,261	480,181	56,920	13.4%
40	606,343	661,037	54,694	9.0%
50	721,155	806,458	85,303	11.8%
60	913,872	915,863	1,990	0.2%
70	958,663	961,186	2,523	0.3%

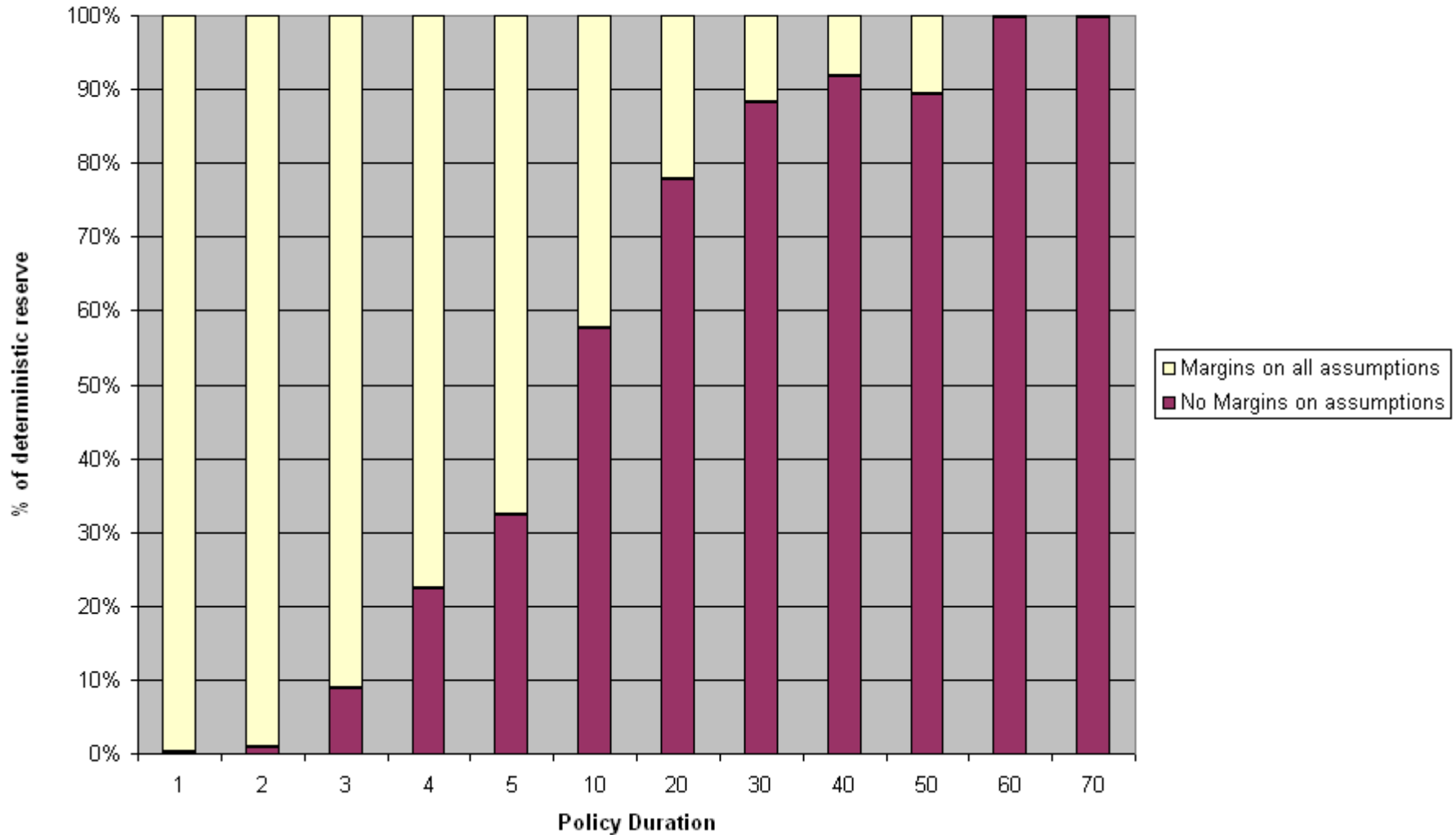


**Numeric Summary - impact of all margins on deterministic reserve****Specified Premium Issue Age 75, Male Best class, \$1M face**

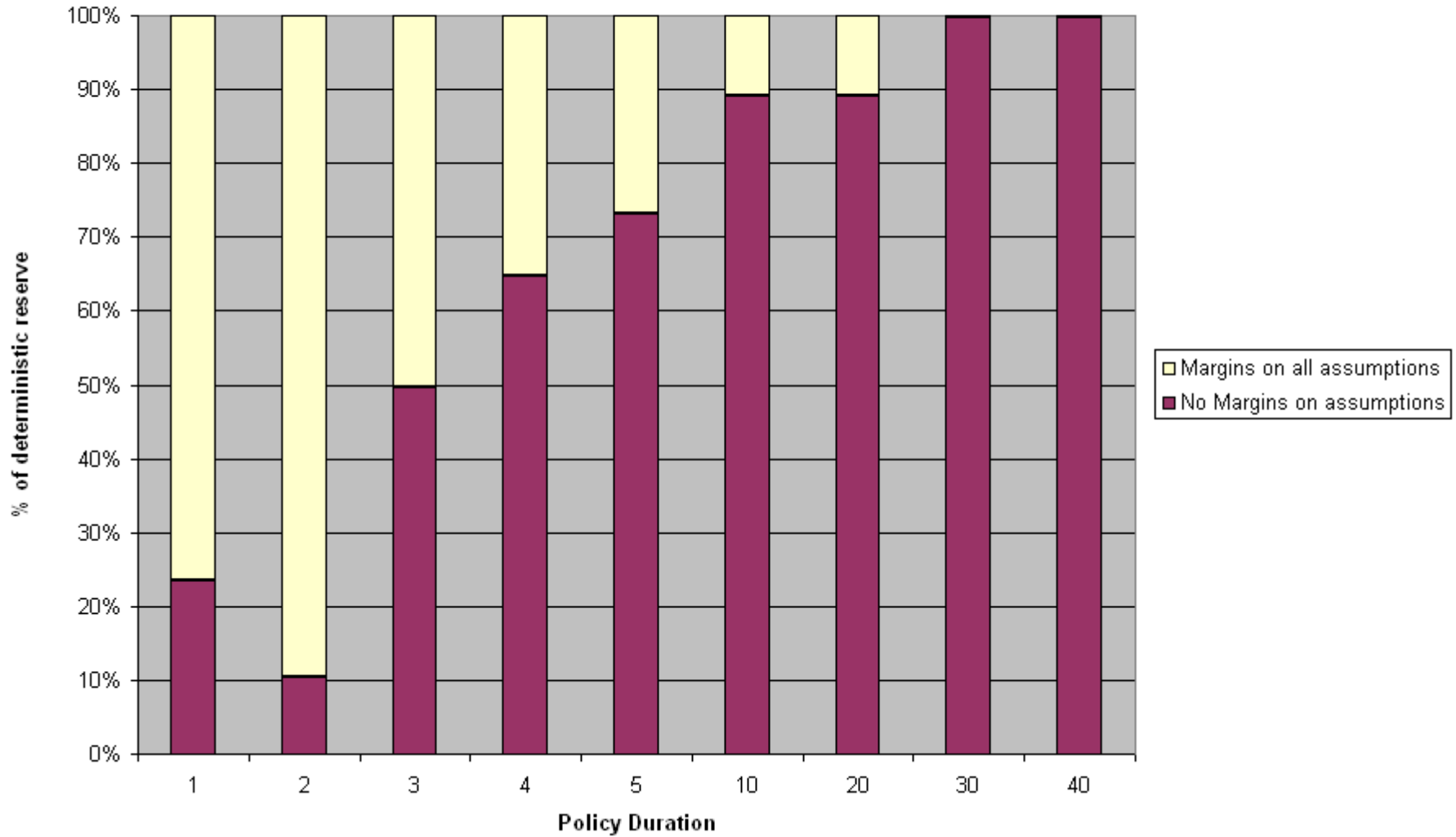
<b>Policy Duration</b>	<b>Deterministic Reserve</b>			
	<b>No Margins on assumptions</b>	<b>Margins on all assumptions</b>	<b>Dollar Margin impact</b>	<b>% Increase</b>
1	776	3,288	2,512	323.9%
2	4,552	43,593	39,040	857.6%
3	42,232	85,032	42,800	101.3%
4	82,047	126,531	44,484	54.2%
5	123,560	168,625	45,065	36.5%
10	337,881	379,491	41,610	12.3%
20	618,235	692,731	74,496	12.0%
30	913,724	915,713	1,990	0.2%
40	958,663	961,186	2,523	0.3%



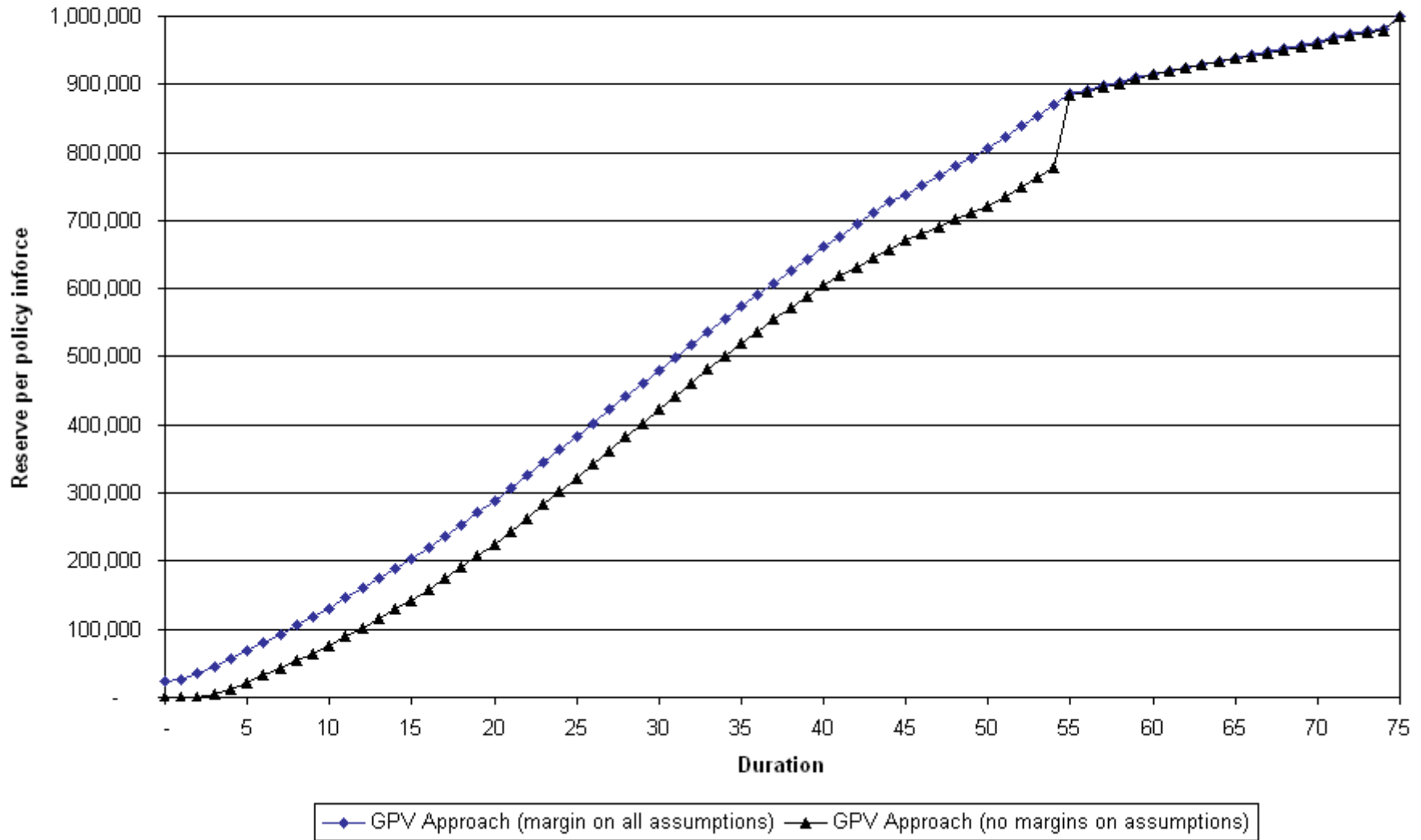
**Impact of margins on deterministic reserve**  
**Specified Premium Issue Age 45, Male Best class, \$1M face**



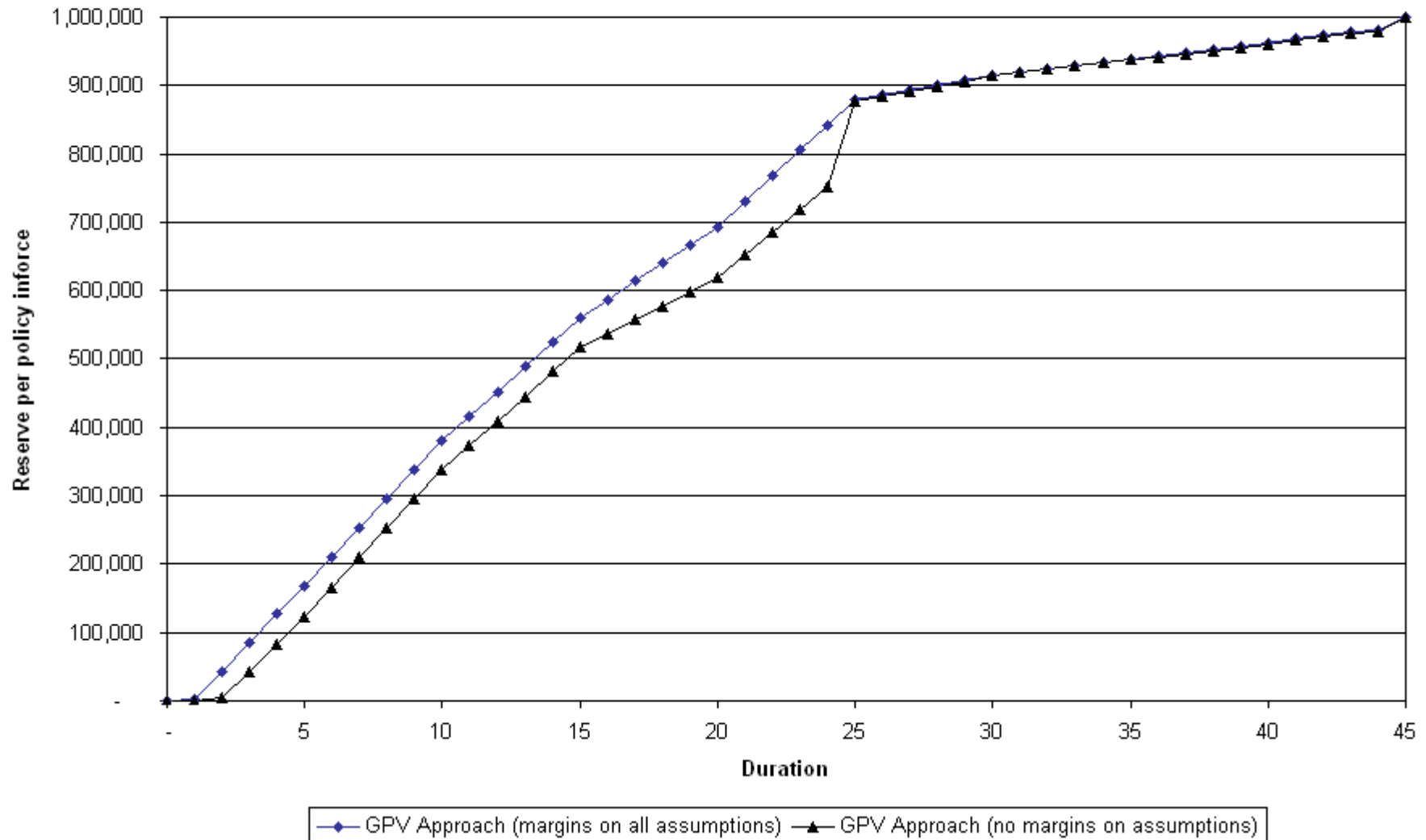
**Impact of margins on deterministic reserve**  
**Specified Premium Issue Age 75, Male Best class, \$1M face**



Impact of margins on all assumptions - deterministic reserve  
 Specified Premium Issue Age 45, Male Best class, \$1M face



Impact of margins on all assumptions - deterministic reserve  
 Specified Premium Issue Age 75, Male Best class, \$1M face



# Margin for Mortality Risk

- Actuary must select a margin between a low and high range to apply to valuation mortality
  - Margin must be between 3.75 and 15 deaths per 1000 per year, each divided by the curtate expectation of life at the insured's attained age at each future point in time.
  - Assumed margin of 7.5 deaths per year for the valuation assumption for this model
- This analysis does not quantify any additional conservatism from:
  - excluding mortality improvement beyond the valuation date
  - credibility weighting to an industry standard valuation mortality table



# Margin for Interest Rate Risk

- Deterministic Scenario has margin in the long-term portfolio rate that is used in the model
  - Padded portfolio rate based on an interest rate scenario that grades to a 65 CTE level of long-term treasury rates
  - Best estimate portfolio rate based on an interest rate scenario that grades to a median level of long-term treasury rates
- Stochastic scenarios use the C-3 Phase I interest rate generator which was recalibrated using historical Treasury rates from 1954-2003



# Controls on asset assumptions

- Existing portfolio of assets are to be modeled in a manner consistent with the company's current investment strategy for the block of business
- Spreads over Treasuries reflected in the purchase yields of reinvestment assets are to be Prudent Best Estimates with an aggregate cap on the spread over Treasuries



# Asset Assumptions used in model

- Initial Portfolio: We have assumed an initial portfolio comprised of a 10-year ladder of corporate bonds with a net portfolio yield of 6.0%
  - Coupon Rate: 6.21% (annual effective rate of 6.3%)
  - Default Rate: 25 bps
  - Investment Expenses: 5 bps
- All future reinvestment is in 10-year non-callable bonds
  - For the model, we have assumed a spread over Treasuries to be 70 bps
- Assumed borrowing rate is based on 3 month treasury + 80 bps



# Deterministic Portfolio Rate used

<u>Year</u>	<u>Net Portfolio Effective Yield</u>	<u>Year</u>	<u>Net Portfolio Effective Yield</u>
1	5.81%	11	4.94%
2	5.69%	12	4.95%
3	5.56%	13	4.96%
4	5.44%	14	4.97%
5	5.34%	15	4.98%
6	5.25%	16	4.99%
7	5.20%	17	5.00%
8	5.12%	18	5.00%
9	5.04%	19	5.00%
10	4.96%	20+	5.00%

- Deterministic Scenario grades to a long-term net portfolio rate of 5%



# Margins for Persistency Risk

- Margins placed on the withdrawal assumption is to adjust best estimate by 20%-40%, but not less than an absolute 1% change
  - Need to see if actuary should increase or decrease withdrawal rates to get an appropriate margin in this assumption
- Impacts from dynamic withdrawals are excluded from the margin quantification
  - (for example, setting withdrawals to 0% when  $AV < 0$ )
- Premium Persistency is 100% for this product, so the margin is applied to the withdrawal rate only



# Margin for Premium Pattern Risk

- Examine demographics of inforce block to arrive at a “best estimate” of future premium payment patterns
- Need to determine the impact of various premium patterns to establish the margin for the premium pattern assumption:
  - Payment of lifetime premiums
  - Payment of no future premiums
  - Minimum premium to keep a guarantee inforce
  - Single premium
  - Short pay premium
- To get the margin for premium payment pattern assumption, assume a higher percentage of policyholders pay at a premium pattern that is disadvantageous to company



# Setting Prudent Best Estimate Premium Patterns

- In this model, the best estimate assumption is that 10% do not pay future premiums, and 90% pay the lifetime premium
  - Based on prior hypothetical experience, assumption is that financial hardships will force some people to discontinue paying premiums.
- The actuary still must run the sensitivity tests on the boundary premium pattern conditions
  - For this product, some of the boundaries are irrelevant
- Based on the results of those sensitivities, the actuary then puts more weight to the premium patterns that are worse for the company



# Setting Prudent Best Estimate Premium Patterns

- In this model, we assumed the prudent best estimate assumption is that 100% of policyholders pay the lifetime premium
- The margin built into premium pattern assumption is difference between this prudent best estimate and best estimate assumption



# Comparison of deterministic reserve to stochastic reserve



# Stochastic Reserve Calculations

- Calculation of the stochastic reserve must be done using an aggregate inforce block of business.
- In this model, an aged 20 year inforce block of business was used
- Interest rate risk is the only assumption that was stochastically modeled



# Distribution of Stochastic Results

- 200 scenarios were run
- For the inforce block of policies at the valuation date, the stochastic CTE (65) is held as the aggregate reserve (figures in 000)

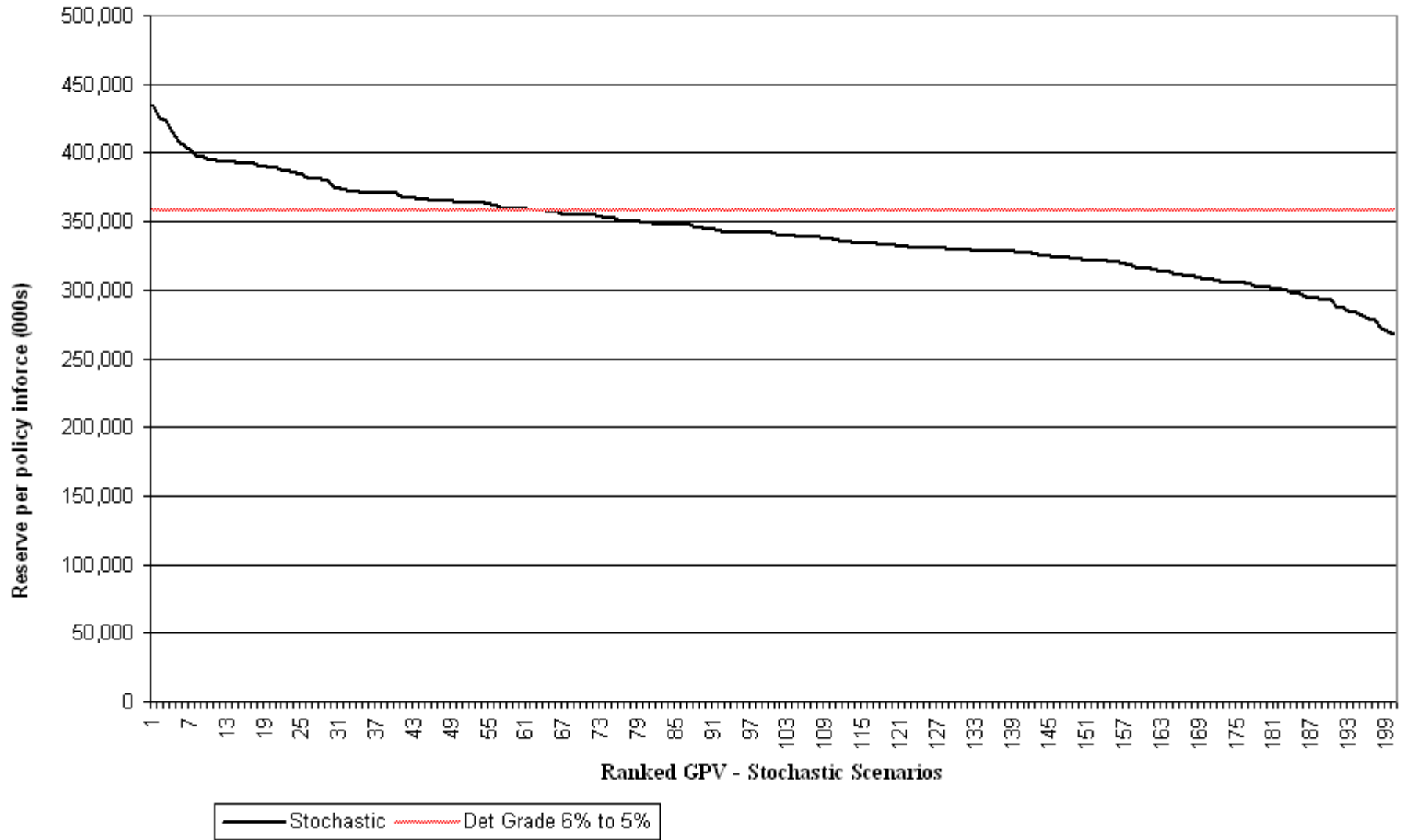
Deterministic Reserve = \$357,709

Stochastic Reserve (65 CTE) = \$377,266

Stochastic/Deterministic 5.5%



**Distribution of Deterministic/Stochastic GPV Results  
Robust 20 year inforce file of Specified Premium UL contracts**



# Comparison of proposed methodology to current formulaic reserve levels



# Comparison to Current Formulaic Reserves

Current formulaic reserves are higher at the valuation date for the inforce block

- Mortality – Current reserve using 80 CSO with an ultimate mortality age of 100. Proposed methodology using ultimate mortality of age 120
- Interest – Current reserve using flat 4.5% for all years. Proposed methodology is using actual company asset strategies and interest scenarios
- Lapses – Current reserve assumes no lapses. Proposed methodology is using padded lapse rates
- X-factors used in formulaic calculations were based on best estimate mortality and were the lowest level allowed



# Reserve comparison for 20 year inforce at valuation date

	Proposed Reserve	Current Formulaic Reserve
Reserve (000s)	\$377,266	\$448,300
Increase in dollars		\$71,034
Increase as percent		18.8%



# ULWG - Summary of Best Estimate and Padded assumptions

## Mortality rates

attained age	Age 45 Cell		Age 75 Cell	
	Val Mort	Padded	Val Mort	Padded
	without pad per 1000	Mortality per 1000	without pad per 1000	Mortality per 1000
45	0.2224	0.4151		
46	0.3183	0.5161		
47	0.3674	0.5705		
48	0.4562	0.6649		
49	0.5678	0.7824		
50	0.7687	0.9894		
51	0.9496	1.1768		
52	1.1477	1.3818		
53	1.3592	1.6005		
54	1.5800	1.8290		
55	1.8197	2.0769		
56	2.1744	2.4403		
57	2.4917	2.7666		
58	2.7872	3.0719		
59	3.1829	3.4780		
60	3.8114	4.1176		
61	4.4188	4.7366		
62	5.0920	5.4224		
63	5.8117	6.1555		
64	6.5463	6.9044		
65	5.9092	6.2827		
66	6.8577	7.2483		
67	7.9747	8.3838		
68	9.4219	9.8510		
69	11.1114	11.5620		
70	13.4597	13.9334		
71	15.6046	16.1030		
72	18.1640	18.6889		
73	20.9711	21.5245		
74	24.0855	24.6696		
75	27.5961	28.2130	5.5528	6.0462
76	30.5314	31.1834	7.5262	8.0511
77	33.9656	34.6558	10.0885	10.6484
78	37.9637	38.6955	12.9070	13.5054
79	42.4461	43.2231	15.2693	15.9105
80	47.4492	48.2751	18.3702	19.0597
81	52.8860	53.7649	21.5041	22.2481
82	58.6120	59.5484	26.0940	26.9002
83	64.8657	65.8646	33.1360	34.0131
84	71.8136	72.8806	40.7750	41.7311
85	79.5422	80.6833	50.0099	51.0548
86	88.0445	89.2658	60.8844	62.0284
87	97.2119	98.5199	73.5564	74.8105
88	106.9432	108.3447	88.1261	89.5009
89	117.1155	118.6179	104.6797	106.1848
90	127.1577	128.7691	120.2869	121.9297
91	136.9541	138.6853	132.5647	134.3548
92	147.1625	149.0284	151.6141	153.5723
93	157.8916	159.9113	173.3319	175.4659
94	169.1339	171.3336	188.5276	190.8343
95	180.1376	182.5542	200.9385	203.4329
96	202.8940	205.5865	217.9577	220.6723
97	227.6781	230.6847	236.1225	239.0836
98	254.6736	258.0370	255.6713	258.9099
99	284.0249	287.7903	276.6744	280.2268
100	318.9860	323.1949	299.2489	303.1576
101	350.5800	355.2192	323.5081	327.8229
102	371.0400	376.0757	349.5512	354.3300
103	392.6600	398.1424	377.4994	382.8078
104	415.4100	421.3983	407.3905	413.2977
105	439.2700	445.8349	439.2700	445.8349
106	464.4700	471.6995	464.4700	471.6995
107	491.1000	499.1028	491.1000	499.1028
108	519.2200	528.1320	519.2200	528.1320
109	548.9100	558.9046	548.9100	558.9046
110	580.2500	591.5531	580.2500	591.5531
111	613.3300	626.2435	613.3300	626.2435
112	648.2100	663.1495	648.2100	663.1495
113	685.0100	702.5721	685.0100	702.5721
114	723.7800	744.8607	723.7800	744.8607
115	764.6300	790.6705	764.6300	790.6705
116	807.6200	841.1528	807.6200	841.1528
117	852.8100	898.9347	852.8100	898.9347
118	900.2800	971.9044	900.2800	971.9044
119	949.9300	1,000.0000	949.9300	1,000.0000
120	1,000.0000		1,000.0000	

## Lapse Assumptions

Duration	Age 45		Age 75	
	Best Estimate	Padded	Best Estimate	Padded
1	4.00%	3.00%	2.20%	1.20%
2	3.80%	2.80%	2.00%	1.00%
3	3.60%	2.60%	1.80%	0.80%
4	3.40%	2.40%	1.60%	0.60%
5	3.20%	2.20%	1.40%	0.40%
6-10	3.00%	2.00%	1.20%	0.20%
11-20	1.80%	0.80%	1.00%	0.00%
21-45	1.20%	0.20%		
46+	1.00%	0.00%		

\* Assume lapses go to 0% if the account value goes negative for both best estimate and padded lapse rates

## Expense Assumptions

	Best Estimate	Padded
<u>Non Acquisition</u>		
Per Policy	\$40.00	\$42.00
% of Prem	0%	0%
Per Unit	\$0	\$0.00
Per Death	\$100.00	\$105.00
Per Surrender	\$20.00	\$21.00
Prem Taxes	2.50%	2.63%

## Deterministic Interest Rates

Year	Best Estimate	Padded
1	5.81%	5.81%
2	5.72%	5.69%
3	5.64%	5.56%
4	5.60%	5.44%
5	5.59%	5.34%
6	5.60%	5.25%
7	5.62%	5.20%
8	5.66%	5.12%
9	5.72%	5.04%
10	5.79%	4.96%
11	5.98%	4.94%
12	6.17%	4.95%
13	6.38%	4.96%
14	6.56%	4.97%
15	6.71%	4.98%
16	6.82%	4.99%
17	6.88%	5.00%
18	6.94%	5.00%
19	6.98%	5.00%
20	6.99%	5.00%
21+	7.00%	5.00%

## Premium Patterns

	Percentage assumed paying	
	Best Estimate	Padded
Lifetime	90%	100%
No Future Pren	10%	0%