SOCIETY OF ACTUARIES

9th Annual Product Development Actuary Symposium
June 2009

1E/2B: Are You Making a Classic Or a Penny Dreadful? Setting Long-Term Assumptions In a Short Term World

Cathy Bierschbach, Greg Roemelt

Product Development Actuary Symposium

2009

Session 1E/2B: Are You Making A Classic Or A Penny Dreadful? Setting Long-Term Assumptions in a Short Term World

a.k.a. Share the Fear

Cathy Bierschbach
Vice President, Life Pricing
June 29, 2009

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Audience Response Keypad

- **Enter you response when you see the answer now button**
- **A light on the keypad will indicate your response was recorded**
- **You may change your response while polling is open**
- **No need to hit the go button**
- **Please leave your keypad at end of session**

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Warm Up Question
## When did you start working full time as an actuary?

a) **2004 or later (5 years or less)**
b) **1999 to 2003 (between 5 and 10 years)**
c) **1989 to 1998 (between 10 and 20 years)**
d) **1988 or earlier (too long to count)**
e) **None of your business**

40%

30%

27%

0%

3%

a) b) c) d) e)
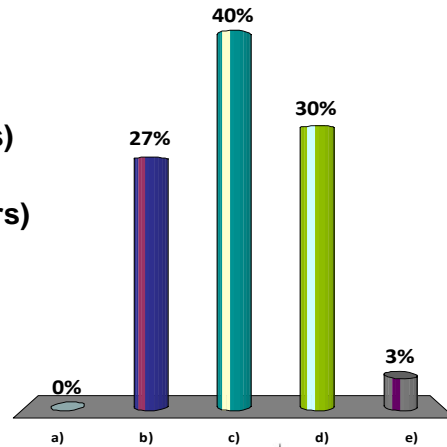
Question #1 – Setting Lapse Assumptions
## How are your lapse assumptions set?

a) **Historical data**
b) **Historical data adjusted for "actuarial judgment"**
c) **"Actuarial judgment"**
d) **Don't ask me – I just use what I'm told to use**

96%

4%

0%

0%

a) b) c) d)
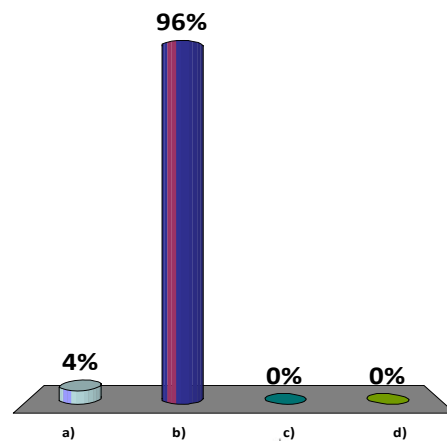
Question #2 – Ultimate UL Lapse
What is your ultimate UL lapse assumption?

a) Same as initial
b) >5%
c) >2% to 5%
d) >1% to 2%
e) <=1%

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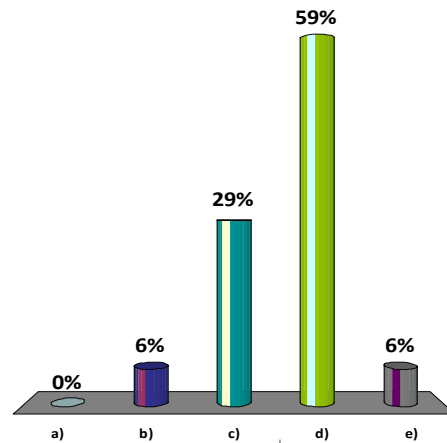
Question #3 – Fine Tuning ULSG Lapses
Do you vary your ULSG lapse assumption by:

a) Attained age and/or duration
b) Relationship between current and shadow account
c) a & b
d) We don't vary
e) c & d

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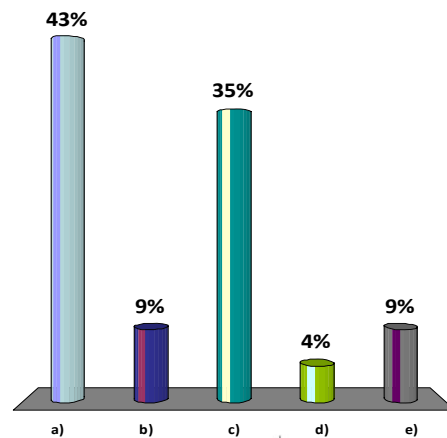
Flaws of Historical Data

- **Changes in the competitive landscape**
  - Term replacement wars
- **Changes in competitive positioning**
- **Ability to get clean, credible data**
  - Especially true when you segment to needed level of detail
- **Appropriate experience may not be there yet**
  - Shock lapses on term
  - Conversion utilization at end of level period
  - Ultimate UL lapse assumption

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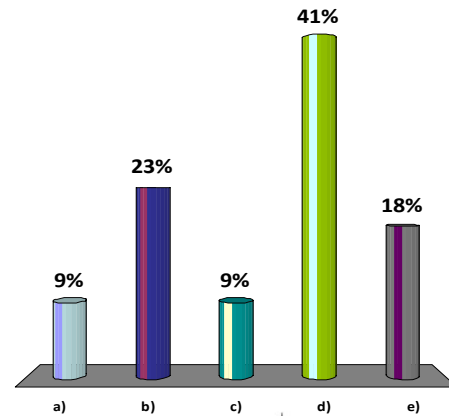
Power of Historical Data

- **If the past is understood, trends may be able to be extrapolated**
- **RGA's "The Term Insurance Market"**
  - Lisa Renetzky presenting tomorrow
- **Canada's "Term to 100" emerging experience**

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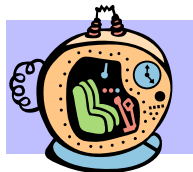
Question #4 – UL Premium Patterns
What do you do to protect from variations?

a) **Slope of charges**
b) **Product features**
c) **Adjusted shadow account interest rates**
d) **Combination of the above**
e) **Huh?**

a)	b)	c)	d)	e)
9%	23%	9%	41%	18%

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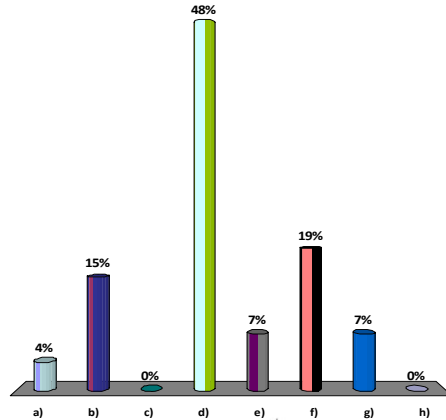Transamerica Life Insurance Company

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UL Premium Patterns

- **Assuming everyone is testing: level, single and short pays**
- **Recent articles**
  - Dialing down guarantees
  - Step pay and grade pay
    - Included strategy of paying target in year one and then dropping down the premium
  - IRR on ROP death benefits
  - Shadow account arbitrage
    - Strategic withdrawals of cash values
  - Catch-up provisions
- **Would you notice the oddities in premium patterns?**
- **What premium should you reflect in your models?**
- **Premium suspension vs. lapsing**

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Question #5 – Mortality Table
What is your base mortality table based on?

a) **7580 Table**
b) **01 VBT**
c) **08 VBT**
d) **Company derived based off 01 VBT**
e) **Company derived based off 08 VBT**
f) **Company derived**
g) **Other**
h) **Do not know and/or care**

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Female Older Age Mortality

Female Preferred Nonsmoker

Company	Age 45 Prem	Age 45 Target	Age 55 Prem	Age 55 Target	Age 65 Prem	Age 65 Target	Age 75 Prem	Age 75 Target	Age 80 Prem	Age 80 Target
A	6,170	7,130	9,830	11,020	16,526	19,100	30,502	28,260	47,771	39,980
B	5,895	7,500	9,656	11,900	16,403	19,000	29,804	35,000	50,640	53,000
C	6,036	8,210	9,751	11,220	16,791	18,600	30,506	30,370	45,986	46,880
D	6,026	6,297	9,497	10,080	15,929	17,291	29,794	31,176	45,860	51,558
E	6,774	7,196	10,214	11,696	16,617	18,596	30,363	31,296	48,683	47,556
F	6,399	8,440	10,287	13,250	15,939	19,060	30,121	32,090	45,868	44,120
G	6,525	6,525	10,892	10,892	20,448	20,448	39,757	39,757	53,041	53,041
H	6,467	6,840	9,815	10,760	16,558	17,580	31,065	29,950	50,383	40,580
I	6,417	7,143	10,132	11,818	16,693	19,830	31,577	32,584	55,643	57,841
Transamerica	**6,212**	**7,620**	**9,840**	**11,720**	**16,924**	**19,500**	**31,920**	**30,580**	**47,811**	**45,280**
% from lowest premium/highest target	5.38%	-9.72%	3.61%	-11.55%	6.25%	-4.64%	7.14%	-23.08%	4.25%	-21.72%
Rank of TransACE	5 of 10	3 of 10	6 of 10	4 of 10	9 of 10	3 of 10	9 of 10	7 of 10	5 of 10	7 of 10

YRT Reinsurance Rates/Pricing Mortality

	Avg 1-5	Avg 6-15	Avg 16-25	Avg 26-35
41-50	112%	126%	185%	171%
51-60	111%	122%	170%	122%
61-70	125%	125%	152%	109%
71-75	138%	124%	132%	103%
76-80	141%	107%	113%	93%
81+	141%	96%	83%	82%

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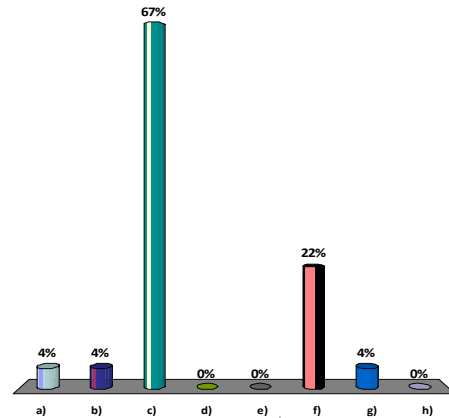INSURANCE & INVESTMENT GROUP
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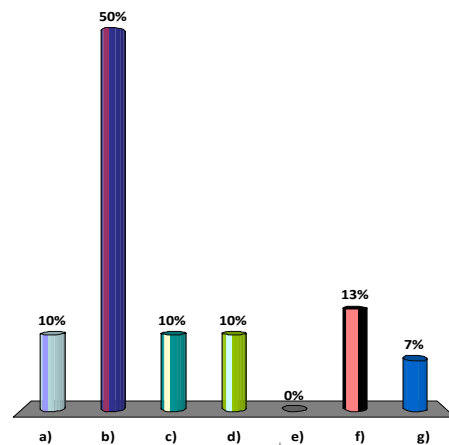**Question #6 – Expenses**
What are your expense assumptions based on?

a) Fully allocated (or close to) as % of premium
b) Fully allocated (or close to) on per policy basis
c) Fully allocated (or close to) on a combination of % of premium and per policy
d) Marginally (or close to) as % of premium
e) Marginally (or close to) on per policy basis
f) Marginally (or close to) on a combination of % of premium and per policy
g) Other
h) Do not know and/or care

67%
22%
4%   4%   0%   0%   4%   0%
a)   b)   c)   d)   e)   f)   g)   h)

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Question #7 – Biggest Fear
What industry issue worries you the most?

a) Post Level Term Profits
b) Reserves & Associated Solutions Or Lack Thereof
c) Premium Patterns
d) Older Age Mortality
e) Pandemic
f) Other
g) Nothing Worries Me

50%
10%   10%   10%   0%   13%   7%
a)   b)   c)   d)   e)   f)   g)

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So how do we set assumptions?

So how do we set assumptions?

- **Carefully after:**
  - Talking to sales and marketing
  - Looking at historical data
  - Looking at new illustrations
  - Lots of scenario testing
  - Looking at impact on various cells

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TOWERS PERRIN

Setting Long Term Assumptions in a Short Term World

Greg Roemelt

June 29, 2009

Importance of Economic Assumptions for Pricing

- Impact on Cash Flows

- Different than liability assumptions
    - Liability assumptions apply to large number of policyholders
    - Economic assumptions can be simulated over a large number of scenarios, but only one scenario will actual occur

Developing Economic Assumptions for Pricing

- Default rates and costs

- Credit spreads

- Call and prepayment behavior

Default Costs

- Traditional Default Cost Development
  - Probability / Severity Approach
  - Both factors varied by quality of Assets
  - Probability may vary over time
  - Severity developed based on recovery rates

Comparison to Reality

- Before defaulting, bonds usually are downgraded
- Historical default rates developed based on initial ratings
- Severity based on long term recovery rates

Deficiencies in the Simplified Approach

- Does not measure increased cost of capital associated with downgrades

- May not measure increased likelihood of default after downgrade

- Does not include a cost of capital for time period between default and ultimate recovery

- Lacks flexibility and is less friendly for stochastic methods

More Robust Methodology for Developing Default Costs

- Develop a matrix of bond upgrades and downgrades

- Use a lattice approach to develop the probabilities of a bond being in the various rating classes at all times

- Probability of default in any period is weighted average of the annual class default rates applied to the amounts in each class.

- Capital associated with asset is based on weighted average capital cost

Example
Moody's One Year Letter Migration Rates

From \ To	Aaa	Aa	A	Baa	Ba	B	Caa	Ca-C	Default
Aaa	91.4%	7.9%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.00%
Aa	1.1%	91.1%	7.4%	0.3%	0.0%	0.0%	0.0%	0.0%	0.02%
A	0.1%	3.0%	91.2%	5.2%	0.5%	0.1%	0.0%	0.0%	0.03%
Baa	0.0%	0.2%	5.1%	89.1%	4.4%	0.8%	0.2%	0.0%	0.17%
Ba	0.0%	0.1%	0.4%	6.2%	83.6%	7.8%	0.6%	0.1%	1.19%
B	0.0%	0.0%	0.1%	0.4%	5.6%	82.7%	5.7%	0.7%	4.66%
Caa	0.0%	0.0%	0.0%	0.3%	0.6%	10.2%	69.7%	4.1%	15.05%
Ca-C	0.0%	0.0%	0.0%	0.0%	0.4%	3.4%	11.5%	48.1%	36.59%

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Example
Impact of Migration Over Time

Rating	Year										
	0	1	2	3	4	5	6	7	8	9	10
Aaa	0%	0%	0%	0%	0%	1%	1%	1%	1%	1%	1%
Aa	0%	3%	5%	7%	9%	10%	12%	12%	13%	14%	14%
A	100%	91%	84%	77%	71%	67%	62%	59%	56%	53%	50%
Baa	0%	5%	9%	13%	16%	18%	19%	21%	22%	23%	23%
Ba	0%	1%	1%	2%	2%	3%	4%	4%	5%	6%	6%
B	0%	0%	0%	0%	1%	1%	1%	2%	2%	2%	3%
Caa	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%
Ca-C	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

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Historical Default Rates, 1970-2008

Rating	Annual Probability of Default
Aaa	0.000
Aa	0.017
A	0.025
Baa	0.172
Ba	1.192
B	4.660
Caa	15.050
Ca-C	36.590

Weighted Average Defaults and C-1 Factors

Year	1	2	3	4	5	6	7	8	9	10
Annual Rate	0.025%	0.048%	0.075%	0.106%	0.140%	0.176%	0.214%	0.253%	0.291%	0.330%
C-1 Factor	0.245%	0.309%	0.376%	0.444%	0.513%	0.581%	0.649%	0.715%	0.779%	0.840%

Impact of Recover Assumption

- Recover assumption translates the probability of default into a cost of default

- Example:
  - Probability of default = 1%
  - Recovery after default = 40%
  - Cost of default = 60bp

- Recovery amounts can be determined from:
  - Market prices immediately after default
  - Ultimate recoveries

- If ultimate recoveries are used, should factor in cost of capital associated with holding securities in default

The Credit Spread Puzzle

- Credit spreads are the difference between yields on corporate debt subject to default risk and risk free Treasury securities

- Credit spreads are generally understood as compensation for credit risk

- But explaining the precise relationship has been difficult

- For example, from 1997 to 2003, average spread on BBB-rated bonds was 170 basis points, by average yearly loss from default was 20 basis points

Decomposing Credit Spreads

- Expected losses
  - Small fraction of overall spread
- Taxes
  - Treasury bonds only subject to Federal tax
  - Corporate bonds taxed by Federal and states
- Risk premium
- Liquidity premium
  - Thin market
  - Risk of market becoming illiquid

Decomposing Credit Spreads

- Difficulty in fully diversifying credit risk
  — Without full diversification, unexpected losses will be priced in the spread
  — Skewed returns

Difficulty in Diversity - CDO Example

- Structure of an Arbitrage CDO
  - Long position in low quality debt paying high spreads
  - Short position in high quality debt paying low spreads
- Hypothetical CDO
  - Collateral pool of Baa bonds with expected loss of 25 bp
  - 175 bp credit spread on Baa
  - Issue Aaa bonds at 50 bp

Difficulty in Diversity - CDO Example

- Typical CDO
  - 100 names in collateral pool, diversity score of 40
  - Can take months to assemble collateral
  - Marginal costs of adding more bonds are high
- Full diversification is not achieved by investors with the most to gain

Implications for Setting Credit Spread Assumptions

- Credit spreads are related to default cost, but also include other factors

- Undiversified risk is another large component of spreads

- The level of spreads associated with undiversified risk is related to default costs

Callable Bonds

- Finance theory shown optimum time to call bond is when it is first in the money

- As usually, reality does not follow theory
  - Firms make irrational decisions
    - Delaying in-the-money calls
    - Calling an out-of-the-money bond

- Implications for asset projection models

Empirical Research

- King an Mauer (2000) examined factors affecting the timing of calls on non-convertible bonds

- Three groups:
  - Called immediately when bond went into the money
  - Called when bond was out of the money
  - Delayed call after bond went into the money

- Significant cost to delaying call

Factors Impacting In The Money Calls

- Opportunity cost of leaving bond outstanding (+)

- Amount of time bond has been in the money (+)

- Slope of the yield curve (+)

Implications For Setting Call Assumptions

- The more calls in are the money, the more likely the bond is to get called

- The longer a bond is in the money, the more likely it is to get called

- Out of the money bonds do get called

- Slope of the treasury curve impacts call behavior

Factors Impacting Mortgage Prepayments

- Refinancing incentive

- Age

- Seasonality

- Burn out

Ross – Roll Model

- Refinancing Incentive
  - Based on minimum and maximum prepayment rates, slope parameter and expected parameter

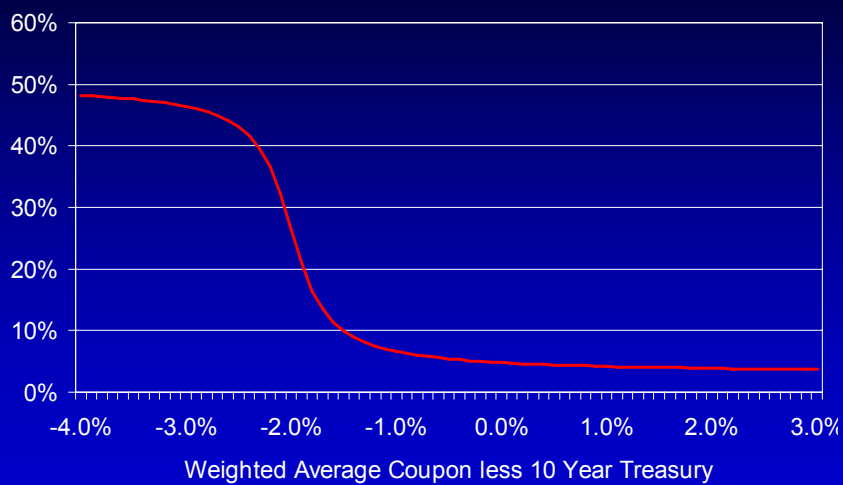$$RI = a + b * acrtan [c + d * (WAC – 10T)]$$

a = Average (MaxCPR,MinCPR)

b = (MaxCPR – a) / ($\pi/2$)

c = 1000 * slope / b

d = - d / expected

Refinancing Incentive

Other factors

- Age = min (month/30, 1)

- Seasonality – factors varying by month

- Burnout
  - =0.3 + 0.7 * outstanding principal / initial principal

Ross – Roll Model

- Monthly prepayments =
  RI * Age factor * Seasonality Factor * Burnout Factor

Burnout

- Not path dependent in Ross/Roll model

- Possible enhancement is to bifurcate pool into two cohorts based on propensity/ability to pre pay

Importance of Asset Assumptions to Pricing

- Impact profitability

- Not always easy to develop
  - Good candidate for sensitivity testing and results distribution analysis

- Testing can be performed over multiple scenarios, but only one will occur

Sources

- Corporate Default and Recovery Rates, 1920 – 2008, *Moody's Global Credit Policy*

- Amato, Jeffery D. and Eli M Remolona, 2003, The Credit Spread Puzzle. *BIS Quarterly Review, 51-62*

- Lipton Amy F., and Nandu Nayar, 2007, Timing of Corporate Callable Bonds: An Empirical Examination Using Survival Analysis