Solving the Puzzle:
Reconciliation of Exposure and Experience Rating

John Buchanan
CARe Seminar – INTMD2
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UNDERWRITERS REINSURANCE, INC.

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INTMD-2:
Solving the Puzzle:
Reconciliation of Exposure and Experience Rating

A simple yet powerful method will be presented that takes the approach that each account is a puzzle to be solved. A reconciliation of the prior sessions results will be given, along with additional credibility considerations between the methods. This session is a continuation of the "Introduction to Exposure and Experience Rating" Case Study that introduces the rating methods.

Moderator/Panelist:
John Buchanan, Senior Vice President, Platinum Underwriters Reinsurance Inc.

Panelists:
Michael E. Angelina, Chief Actuary and Chief Risk Officer, Endurance Specialty Holdings, Ltd.
Stephen Philbrick, Vice President, Swiss Reinsurance America Corporation

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Agenda

- Introduction to Hybrid Method (20 mins – John)
- Credibility Issues (20 mins – Steve)
- Reconciliation of the Results (20 mins – Mike)
- Questions
- Appendix

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Solving the Puzzle

- Traditional Methods Recap
- Hybrid Method: Experience / Exposure
  - Reserving analogy
  - Fundamental assumptions
  - Basic steps
  - Case study challenges
    - Changing policy limits
    - Clash contracts

Appendix
  - Other considerations in attempting to solve the puzzle
  - Underwriting cycle: soft market experience model bias
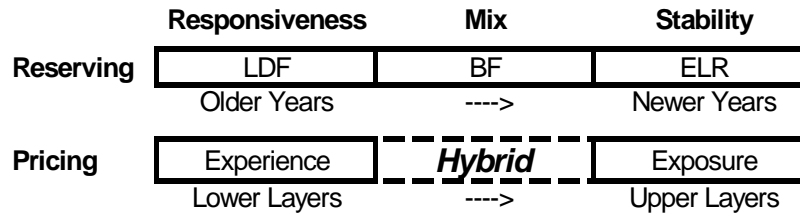
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Traditional Methods Recap

Experience	Exposure

• Relevant parameter defaults/overrides for:
  – LDFs (excess layers)
  – Trends (severity, frequency, exposure)
  – Rate changes
  – LOB/Hazard Grp indicators
• Adjust for historical changes in:
  – Policy limits
  – Exposure differences
    ○ Careful "as-if"
	• Relevant parameters defaults/overrides for:
	  – ILFs (or ELFs, PropSOLD)
	  – Direct loss ratios (on-level)
	  – ALAE loads
	  – Policy profile (LOB, HzdGrp)
	    ○ Limit/subLOB allocations
	• Adjust for expected changes in:
	  – Rating year policy limits
	  – Rating year exposures expected to be written

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Hybrid Pricing Method
Reserving Analogy

	Responsiveness	**Mix**	**Stability**
Reserving	LDF	BF	ELR
	Older Years	---->	Newer Years
Pricing	Experience	*Hybrid*	Exposure
	Lower Layers	---->	Upper Layers

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Fundamental Assumptions
of the Hybrid Method

- In **theory**, with perfect modeling and sufficient data the results under the Experience and Exposure methods will be identical. *(never attainable)*

- In **practice**,
  - if the model and parameter selections for both Experience and Exposure methods are proper and relevant,
  - then the results from these methods will be similar,
  - except for credibility and random variations.
- Lower layer experience helps predict higher less credible layers.
- Frequency is a more stable indicator than total burn estimates.

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Basic Steps of The Hybrid Method

1. Estimate Experience burns & counts
2. Estimate Exposure burns & counts
3. Calculate Experience/Exposure frequency ratio by attachment point
4. Review Hybrid frequency ratio patterns
   - Adjust experience or exposure models if needed and re-estimate burns
5. Similarly review excess severities and/or excess burns
6. Combine Hybrid frequency/severity results
7. Determine overall weight to give Hybrid

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Step 1d-Recap: Estimation of Experience Burns, Counts and Implied Severities

Layer (Limit xs Retention)			Experience - Traditional Burning Cost Method			
			Indicated Experience Burn (%)	Ultimate Loss (USD)	Excess Claim Counts	Implied Severity
50,000	xs	200,000	1.19%	1,322,008	27.05	48,874
100,000	xs	250,000	1.52%	1,691,358	24.54	68,919
150,000	xs	350,000	0.89%	984,586	12.05	81,695
500,000	**xs**	**500,000**	**0.41%**	456,121	**2.69**	169,751
250,000	**xs**	**750,000**	**0.09%**	95,024	**0.54**	176,822
1,000,000	**xs**	**1,000,000**	**0.03%**	30,874	**0.36**	86,177

To be compared to exposure counts

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Step 2: Estimation of Exposure Burns
Bifurcated Between Counts and Severities

	Layer		Exposure Method			
			Indicated Exposure Burn (%)	Ultimate Loss (USD)	Benchmark Excess Claim Counts	Benchmark Severity
50,000	xs	200,000	1.51%	1,671,633	38.05	43,937
100,000	xs	250,000	1.92%	2,134,498	29.80	71,616
150,000	xs	350,000	1.33%	1,481,529	15.34	96,588
500,000	**xs**	**500,000**	**1.54%**	1,709,680	**6.00**	285,088
250,000	**xs**	**750,000**	**0.27%**	296,553	**1.90**	156,416
1,000,000	**xs**	**1,000,000**	**0.27%**	304,773	**0.77**	398,338

12.05 exper / 15.34 expos = 78.6%

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Step 3/4- Review Hybrid Frequency Ratios

	Layer		Exposure Method		Indicated Exper/Expos Freq Ratio	Selected Exper/Expos Freq Ratio	Hybrid Method
			Indicated Exposure Burn (%)	Benchmark Excess Claim Counts			Selected Excess Claim Counts
50,000	xs	200,000	1.51%	38.05	**71.1%**	**80.0%**	30.44
100,000	xs	250,000	1.92%	29.80	**82.3%**	**80.0%**	23.84
150,000	xs	350,000	1.33%	15.34	**78.6%**	**80.0%**	12.27
500,000	**xs**	**500,000**	**1.54%**	**6.00**	**44.8%**	**80.0%**	**4.80**
250,000	xs	750,000	0.27%	1.90	**28.3%**	**80.0%**	1.52
1,000,000	**xs**	**1,000,000**	**0.27%**	**0.77**	**46.8%**	**80.0%**	**0.61**
Total			1.81%		**75.1%**	80.0%	

80.0%

Important Selection   *6.00 expos x 80.0%*

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Step 4a: Review Exper/Expos Frequencies
Attachment Point Pattern: 200k…1mm

**Frequency of Excess Claims by Attachment Point
By Projection Method**

Expos and Exper count ratios relatively consistent through 350k- IF experience very credible, then perhaps pressure to reduce exposure L/R; check out spikes
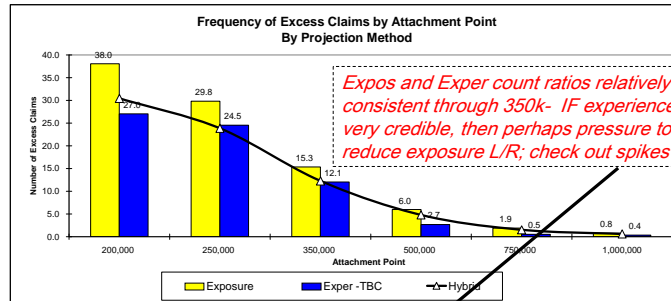
Att Pt.	# of Claims Expected in Rating Year			Exper/ Expos Ratio
	Exposure	Exper -TBC	Hybrid	
200,000	38.0	27.0	30.4	71.1%
250,000	29.8	24.5	23.8	82.3%
350,000	15.3	12.1	12.3	78.6%
500,000	6.0	2.7	4.8	44.8%
750,000	1.9	0.5	1.5	28.3%
1,000,000	0.8	0.4	0.6	46.8%

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Step 4b: Inspect Experience/Exposure Ratios by Attachment Point

Exper/
Expos
Ratio

Layers
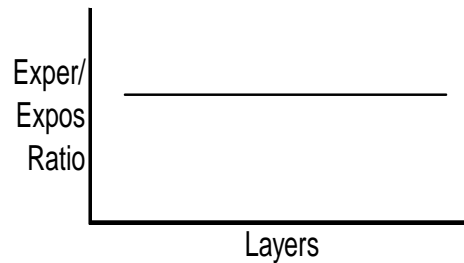
Ideal Situation
- No noticeable slope to ratio of Experience/Exposure
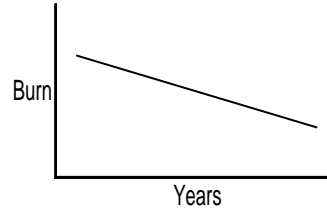- Random fluctuation around mean

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Step 4c: Pressure Indicators - Inspect Burn ratios by Year

Upward slope pressure indicators:
- Not enough trend
- Too much LDF
- Too much later year rate change
- Too much earlier year rate change
...

Downward slope pressure indicators:
- Too much trend
- Not enough LDF
- Not enough later year rate change
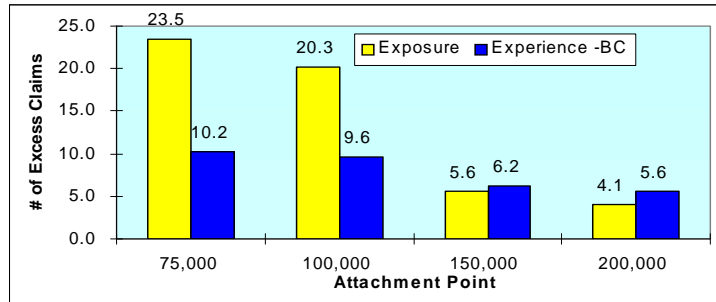- Not enough earlier year rate change
...

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Steps 1-7: Bringing it All Together

A. Experience Method - Traditional Burning Cost (USD) — *step 1*

Subject Premium: 111,000,000

1	2	3	5	6	7	8
			Experience Method - TBC			
	Layer (Limit xs Retention)		Indicated Experience Burn (%)	Ultimate Loss (USD)	Excess Claim Counts	Implied Severity
			[5xSPI]			[6/7]
1	50,000 xs 200,000		1.19%	1,322,008	27.05	48,874
2	100,000 xs 250,000		1.52%	1,691,358	24.54	68,919
3	150,000 xs 350,000		0.89%	984,586	12.05	81,695
4	500,000 xs 500,000		0.41%	456,121	2.69	169,751
5	250,000 xs 750,000		0.09%	95,024	0.54	176,822
6	1,000,000 xs 1,000,000		0.03%	30,874	0.36	86,177
	Total		0.44%	486,996	2.69	181,241

C. Experience / Exposure Indicated and Selected Ratios — *step 3* / *step 5*

10	11	12	13	14	15
Indicated Exper/Expos Freq Ratio	Selected Exper/Expos Freq Ratio	Base Layer Weights	Devt/Trended # of Claims	Actual # of Claims	Weight to Experience Severity
[A7/B7]	[f/ 13]				
71.1%	80.0%	39.9%	189.4	178	100.0%
82.3%	80.0%	36.5%	173.4	129	100.0%
78.6%	80.0%	18.1%	85.8	54	85.0%
44.8%	80.0%	4.5%	21.3	11	22.5%
28.3%	80.0%	0.6%	3.1	2	5.0%
46.8%	80.0%	0.4%	2.1	0	2.5%
75.1%	80.0%	100.0%	475.0	374	
	80.0%				

step 4

B. Exposure Method (USD) — *step 2*

1	2	3	5	6	7	8
			Exposure Method			
	Layer (Limit xs Retention)		Indicated Exposure Burn (%)	Indicated Ultimate Loss (USD)	Benchmark Excess Claim Counts	Benchmark Severity
			[5xSPI]			[6/7]
1	50,000 xs 200,000		1.51%	1,671,633	38.05	43,937
2	100,000 xs 250,000		1.92%	2,134,498	29.80	71,616
3	150,000 xs 350,000		1.33%	1,481,529	15.34	96,588
4	500,000 xs 500,000		1.54%	1,709,680	6.00	285,088
5	250,000 xs 750,000		0.27%	296,553	1.90	156,416
6	1,000,000 xs 1,000,000		0.27%	304,773	0.77	398,338
	Total		1.81%	2,014,454	6.00	335,909

D. Hybrid Method (USD) — *step 6*

10	11	12	13
		Hybrid Method	
Selected Excess Claim Counts	Selected Severity (Wtd)	Selected Hybrid Burn (%)	Selected Ultimate Loss
[B7xC11]	[f/ A8,B8,C15]	[13/SPI]	[10x11]
30.44	48,874	1.34%	1,487,569
23.84	68,919	1.48%	1,643,296
12.27	84,218	0.93%	1,033,439
4.80	259,137	1.12%	1,243,242
1.52	157,436	0.22%	238,790
0.61	390,534	0.22%	239,042
		1.34%	1,482,284

step 7

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Case Study Challenge
(Changing Policy Limits - Example #2)

- **In this case study, there is an inconsistent relationship as move up the attachment points**
- **While the low layer Experience is about half of Exposure, the upper layers are about equal to Exposure**
- **Need more investigation to reconcile and help solve the puzzle**

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Adjusting Experience for historically higher policy limits

Hybrid Analysis - Example #2 (before investigation)

1	2		3	4	5	6	7	8
	Layer (Limit xs Retention)			Experience Excess Claim Counts	Exposure Excess Claim Counts	Indicated Exper/Expos Freq Ratio	Indicated Exper/Expos Burn Ratio	Devt & Trended # of Claims
						[4/5]		
1	125,000	xs	75,000	10.2	23.5	43.4%	43.4%	54.8
2	**100,000**	**xs**	**100,000**	**9.6**	**20.9**	**45.8%**	**47.3%**	51.3
3	350,000	xs	150,000	6.2	5.6	110.1%	86.3%	32.9
4	300,000	xs	200,000	5.6	4.1	135.5%	96.1%	28.4
	Total / Average					72.9%	61.9%	

Hybrid Summary - Example #2 (after investigation)

1	2		3	4	5	6	7	8
	Layer (Limit xs Retention)			Experience Excess Claim Counts	Exposure Excess Claim Counts	Indicated Exper/Expos Freq Ratio	Indicated Exper/Expos Burn Ratio	Devt & Trended # of Claims
						[4/5]		
1	125,000	xs	75,000	10.2	23.5	43.4%	43.4%	54.8
2	**100,000**	**xs**	**100,000**	**9.1**	**20.9**	**43.5%**	**44.9%**	51.3
3	350,000	xs	150,000	3.7	5.6	66.1%	56.1%	32.9
4	300,000	xs	200,000	2.2	4.1	54.2%	38.4%	28.4
	Total / Average					49.7%	45.5%	
				Selected Hybrid frequency ratio		50.0%		

- Investigating the analysis more deeply, we noticed that the historical policy limits are significantly higher than the projected policy limits. The "after investigation" analysis incorporates an adjustment to our experience analysis to reflect lower rating year limits.

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Case Study Challenge
Adjusting Exposure for clash potential

Hybrid Analysis - Example #3 (before investigation)

1	2		3	4	5	6	7	8
						Experience Method - TBC		
	Layer (Limit xs Retention)			Experience Excess Claim Counts	Exposure Excess Claim Counts	Indicated Exper/Expos Freq Ratio	Indicated Exper/Expos Burn Ratio	Developed & Trended # of Claims
						[4/5]		
1	1,000,000	xs	1,000,000	16.0	23.5	67.9%	77.9%	106.7
2	1,000,000	xs	2,000,000	7.5	8.8	84.5%	85.6%	48.1
3	1,500,000	xs	3,500,000	3.4	4.5	76.3%	91.7%	22.3
4	2,500,000	xs	5,000,000	2.1	3.0	71.9%	73.9%	14.7
5	2,500,000	xs	7,500,000	1.06	1.32	81.0%	74.8%	8.5
6	10,000,000	xs	10,000,000	0.64	0.48	134.0%	212.9%	4.4
7	15,000,000	xs	20,000,000	0.43	0.11	386.4%	372.7%	2.5
8	25,000,000	xs	35,000,000	0.00	0.03	0.0%	0.0%	0.0
	Total / Average					78.8%	90.7%	

Hybrid Analysis - Example #3 (after investigation)

1	2		3	4	5	6	7	8
						Experience Method - TBC		
	Layer (Limit xs Retention)			Experience Excess Claim Counts	Exposure Excess Claim Counts	Indicated Exper/Expos Freq Ratio	Indicated Exper/Expos Burn Ratio	Developed & Trended # of Claims
						[4/5]		
1	1,000,000	xs	1,000,000	16.0	22.2	71.9%	81.7%	106.7
2	1,000,000	xs	2,000,000	7.5	8.8	85.1%	86.2%	48.1
3	1,500,000	xs	3,500,000	3.4	4.5	75.4%	90.4%	22.3
4	2,500,000	xs	5,000,000	2.1	3.0	70.6%	71.2%	14.7
5	2,500,000	xs	7,500,000	1.06	1.47	72.4%	66.8%	8.5
6	10,000,000	xs	10,000,000	0.64	1.07	59.8%	89.5%	4.4
7	15,000,000	xs	20,000,000	0.43	0.48	88.6%	79.9%	2.5
8	25,000,000	xs	35,000,000	0.00	0.13	0.0%	0.0%	0.0
	Total / Average					75.2%	82.7%	
					Selected Hybrid frequency ratio	85.0%		

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Benefits of Hybrid Method

- One of main benefits is questioning Experience and Exposure Selections
  - To the extent credible results don't line up, this provides pressure to the various default parameters
  - For example, there would be downward pressure on default exposure ILF curves or loss ratios if
    - Exposure consistently higher than experience, and
    - Credible experience and experience rating factors
- A well constructed Hybrid method can sometimes be given 100% weight if credible
- Can roll-up Hybrid results across accounts to evaluate pressure on industry defaults

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Other Considerations in Attempting to Solve the Puzzle

Appendix

- Credibility
- Rolling-up Accounts and Reconciling to Industry Defaults
- Underwriting Cycle

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Credibility

Experience Rating = Projection of losses based only on what took place for this specific account

Exposure Rating = *A Priori* estimate of losses based on information other than the specific account's experience in the layer
- Other similar accounts
- "Industry"

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Credibility

•Separating claim counts is useful for comparing experience and exposure ratings, and also for gauging credibility.

•A good credibility standard is: the number of claims that we would have expected to observe in the historical periods.

$$Z = \frac{n}{n + k}$$

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Credibility: Other Considerations

• Stability of Experience: How much would experience rate change if we remove the largest claim or add an additional full limit loss?

• Are pricing factors (LDFs, rate changes, etc) from the account or are they default values?

• Do the characteristics of the ceding company match the business in the exposure rating curves?

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Assessing Credibility of Exposure Method

- Assess confidence due to:
  - Exposure curve selected
  - Exposure profile
  - Source of hazard or sub-line information
  - Prediction of next years primary loss ratio
  - Percentage of non-modeled exposure, clash, etc.
  - Company strategy and ability to realize strategy
- Possibly take questionnaire / scoring approach to mechanize (Patrik/Mashitz)

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Assessing Credibility of Experience Method

- Assess confidence due to:
  - Overall volume of claims
  - Volume of claims within layer *(lucky or unlucky?)*
  - Stability of year by year Experience results
  - "   layer to layer Hybrid ratios
  - Source of loss development, trend factors, historical rate changes and deviations
  - Changes in historical profile limits affecting claims
  - Appropriateness of any claims or divisions that may have been removed (or "as-if'd")
  - Including additional large claim(s) if feel account "lucky"
    - Underwriter "as-if" scorecard – soft market
- Experience score compared to exposure score to determine credibility weight

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Classical Credibility Weighting Techniques

- Select credibility weights using combination of:
  - Formulaic Approach
    - Expected # of Claims / Variability
    - Exposure ROL (or burn on line)
  - Questionnaire Approach
    - Apriori Neutral vs. Experience vs. Exposure
    - Patrik/Mashitz paper
  - Judgment
- Need to check that burn patterns make sense
  - i.e. higher layer ROL < lower ROL
  - similar to Miccolis ILF consistency test
  - plot ROL's to see if pattern makes sense

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Classical Credibility Weighting

Limit	Retention	Experience	Exposure	Credibility Weight	Selected Burn
50,000	200,000	1.19%	1.50%	100.0%	1.19%
100,000	250,000	1.52%	1.91%	90.0%	1.56%
150,000	350,000	0.89%	1.33%	75.0%	1.00%
500,000	500,000	0.41%	1.53%	50.0%	0.97%
250,000	750,000	0.09%	0.27%	25.0%	0.22%
1,000,000	1,000,000	0.03%	0.27%	10.0%	0.25%

o *Credibility weights can be judgmentally or formula selected*

o ***Soft market pressure*** *to give more weight to experience indication when lower (perhaps implicitly by underwriter or management override)*

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Increase Credibility
by Reducing Variability
FIGURE 1
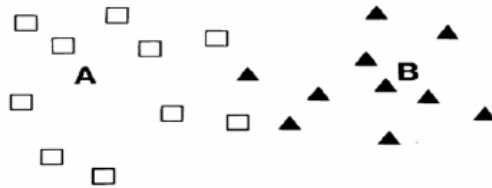
- Above figure from iconic Philbrick CAS paper
- In this case, A represents Experience rating average (with indicated process noise), while B represents Exposure
- Goal will be to bring A and B closer together thereby reducing parameter variance, with any remaining difference being process noise

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Roll-up Results across Accounts

Test of Default Parameters

- Aggregate across "similar" accounts to evaluate pressure on industry defaults
  - May want to re-rate accounts using e.g. default rate changes, ILFs, premium allocations, LDFs, trends, etc.
- Each individual observation represents a cedant/attachment point exper/expos ratio
- Review dispersion of results and overall trend
  - E.g. if weighted and/or fitted exper/expos ratios are well below 100% (or e.g. 90% if give some underwriter credit) then perhaps default L/Rs overall are too high (or conversely LDFs or trends too light)
  - If trend is up when going from e.g. 100k to 10mm att pt, then perhaps expos curve is predicting well at lower points but is underestimating upper points
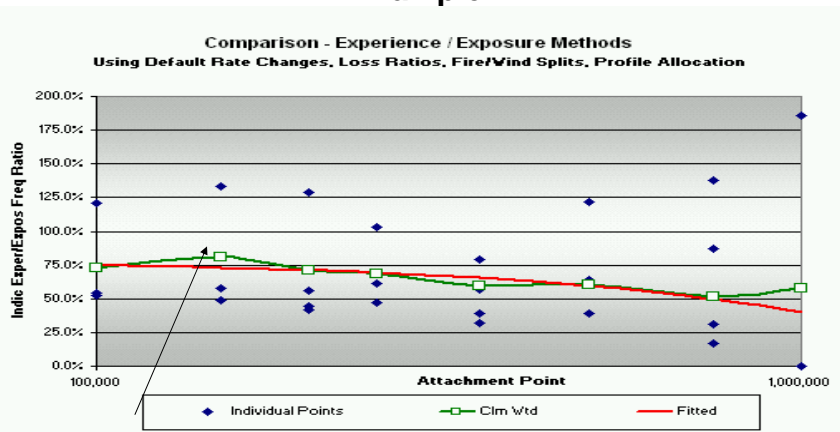
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Roll-up Results across Accounts

Test of Default Parameters *(cont.)*

- Before making overall judgments, must consider
  - UW contract selectivity (contracts seen vs. written),
  - Sample size (# of cedants/years),
  - Impact "as-if" data (either current or historical)
  - Survivor bias
  - Systematic bias in models
  - "Lucky"

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# Hybrid roll-ups: Test of Default Factors
Example 1

Comparison - Experience / Exposure Methods
Using Default Rate Changes, Loss Ratios, Fire/Wind Splits, Profile Allocation

Well below 100%, pressure to reduce expos params or increase exper params…but credible??

Average Exper/Expos Freq Ratio	
Arithmetic Avg:	65.1%
Sumproduct(clms)	72.5%

Dispersion Statistics		
Total # >90%=	7	25.9%
Total 0>#<90%=	20	74.1%
Total # >0%=	27	100.0%
Total # = 0	3	
Total # =	30	
U/W Selectivity =	90.0%	

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Test of Default Rating Factors – Example 2
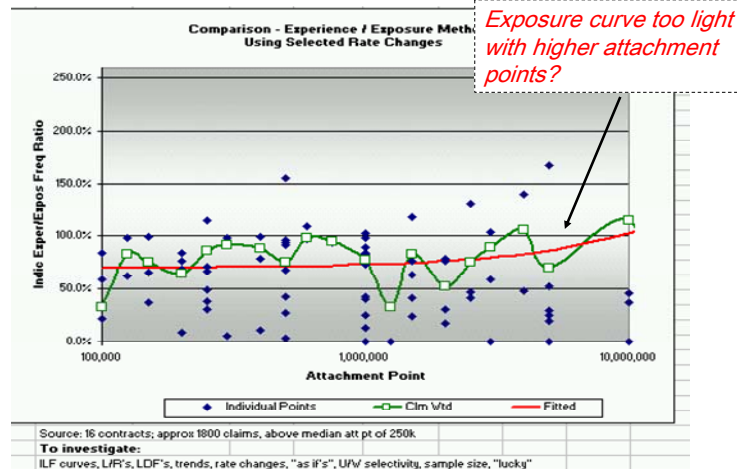
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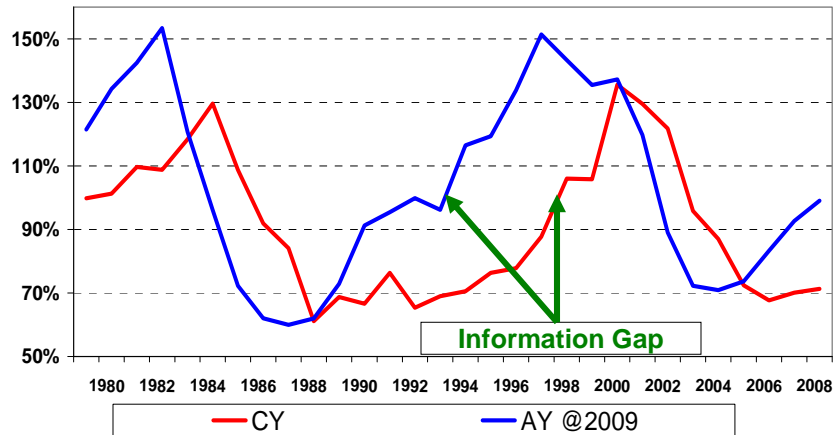# Underwriting Cycle

- Hard market vs. Soft market
- Calendar year vs. accident year
  - Difficulty in estimating true results – information lag
  - Sometimes takes years to properly estimate
  - Wrong signal consequences
- Forensic analysis of cycle
  - Numerator impacts (loss trends, new plateaus, shock losses)
  - Denominator impacts (rate changes, terms and conditions)
- Relative magnitude of components
  - Losses
  - Rates
  - Reserve adequacy (no impact if able to review "true" AY results)
  - Which is larger impact, losses or rates? Perhaps vary by line
- Hypothesis
  - Soft market bias towards Experience model results
  - Could be implicit by underwriters or management override

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Underwriting Cycle - CY vs. AY
Operating Ratio

Information Gap

Source: MPL Sch P @ 12/31/2009 by Rich Lino - Oliver Wyman
AY reported results including IBNR reported as of December 31, 2008 (or 9 years after AY, if earlier)
AY estimates reflect investment yield of 0.5% above 5-year US Teasury Rate

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Underwriting Cycle – CY vs. AY
Apparent vs. Actual Market Signals

# Years	Actual - AY			
Apparent - CY	Hard	Transitional	Soft	Total
Hard	3	7	3	13
Transitional	5	0	7	12
Soft	0	2	3	5
Total	8	9	13	30

Avg. LR Gap	Actual - AY			
Apparent - CY	Hard	Transitional	Soft	Total
Hard	2.1%	24.5%	48.4%	24.8%
Transitional	-26.0%	0.0%	37.5%	11.1%
Soft	0.0%	-33.1%	-1.9%	-14.4%
Total	-15.5%	11.7%	30.9%	

Red Years = CY indications -> write MORE business, while actual results much WORSE (average=37% worse)
Blue Years = CY indications -> write LESS business, while actual results much BETTER (average = 28% better)

Source: MPL Sch P @ 12/31/2009 by Rich Lino - Oliver Wyman

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Historical Look at MPL Industry UW Performance - AY
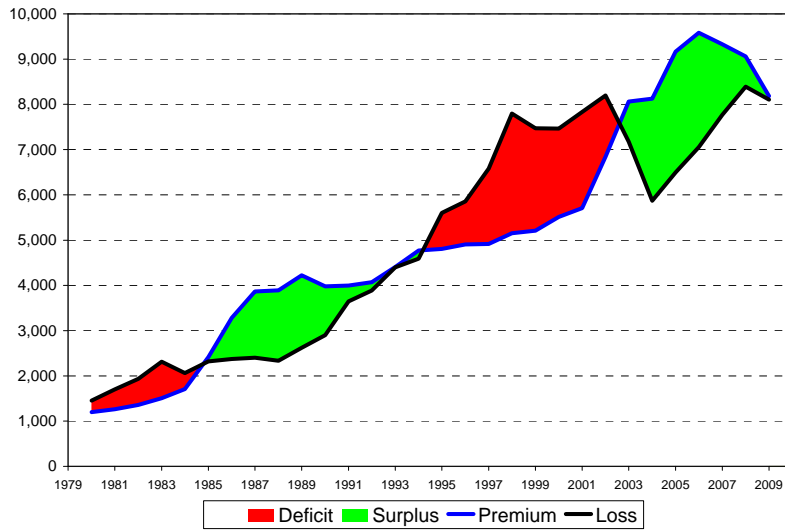
Source: Sch P @ 12/31/2009 by Rich Lino - Oliver Wyman
AY reported results including IBNR reported as of December 31, 2008 (or 9 years after AY, if earlier)
AY estimates reflect investment yield of 0.5% above 5-year US Teasury Rate

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