How Reasonable is Your Range?

Exploring Relationships of Uncertainty among Estimates of Ultimate and Unpaid Claims

Casualty Actuarial Society
Fall 2013 Meeting

Minneapolis, Minnesota

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Ground-Rules for our Discussion

Including disclaimers

- This presentation is prepared and intended for general educational and discussion purposes only.
- It should not be used as a substitute for consultation with professional advisors.
- The views and opinions expressed by the panelists may or may not be reflective of their own personal views and opinions; the views and opinions are not expressions of position by their employers.
- Enjoy the exchange of information and ideas.
- Contribute.

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Your Panelists

- Mark Littmann, FCAS, MAAA
  - Principal, PwC-Hartford
- Sun Sun, ACAS
  - Associate, PwC-Hartford

Outline for our Discussion

- A Framework for Thinking about Ranges
- Illustrations
- Validating the Framework
- Examples
- Take-Away's

Ranges of Estimates

- We're talking about ranges of estimates that are considered reasonable.
  - Based on data and information available at a point in time for the analysis of estimated ultimates and the associated unpaid amounts.
- We're **not** talking about distributions of possible outcomes.

Question

For a typical book of **Personal Auto Liability** business . . .

. . . what is your view for a **range of reasonable estimates of the reserves**?

Question

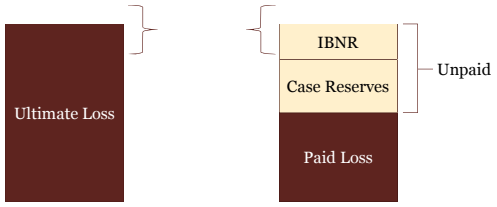
What is your view for a **range of reasonable estimates of the reserves . . .**

. . . for **Homeowners Multi-Peril**?

A Framework for Thinking about It

Consider the uncertainty associated with the estimate of ultimate loss.

Then, consider the implications of that in the relation to the portion of ultimate loss that is unpaid.



And then, how does your uncertainty decrease as the exposure period matures over time?

Illustration

Years Since Inception	Premium (1)	Ultimate Loss (2)	Paid to Date % (3)	Paid to Date (4)	Loss Reserve (5)	Reasonability Metrics: % of Premium (6)	Reasonability Metrics: Amount (7)	Reasonability Metrics: % Reserve (8)
1	100	75	65%	49	26	3.0%	3	11%

For a 'start-up' operation with one year of business, with 65% of the estimated ultimate losses paid so far, confidence that the ultimate loss pick is reasonable within 3 points (of premium) implies that the reserve pick is reasonable within 11% in relation to the reserve.

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Illustration

Years Since Inception	Premium (1)	Ultimate Loss (2)	Paid to Date % (3)	Paid to Date (4)	Loss Reserve (5)	Reasonability Metrics: % of Premium (6)	Reasonability Metrics: Amount (7)	Reasonability Metrics: % Reserve (8)
1	100	75	65%	49	26	3.0%	3	11%
2	100	75	85%	64	11	2.0%	2	18%
Sum	200	150		113	38		5	13%

By the second year of operation, confidence that the current year ultimate loss pick is within 3 points, and that the prior year loss pick is within 2 points, implies that the reserve pick is reasonable within 13% of the reserve.

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Illustration

Years Since Inception	Premium (1)	Ultimate Loss (2)	Paid to Date % (3)	Paid to Date (4)	Loss Reserve (5)	Reasonability Metrics: % of Premium (6)	Reasonability Metrics: Amount (7)	Reasonability Metrics: % Reserve (8)
1	100	75	65%	49	26	3.0%	3	11%
2	100	75	85%	64	11	2.0%	2	18%
3	100	75	90%	68	8	1.3%	1	18%
4	100	75	95%	71	4	0.9%	1	24%
5	100	75	100%	75	0	0.0%	0	
Sum	500	375		326	49		7	15%

In a 'steady state,' confidence on the current year pick of 3 points, and improvement of that by 33% as each year matures, implies a reserve range of 15%.

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Illustration
Reduce the Uncertainty

Years Since Inception	Premium (1)	Ultimate Loss (2)	Paid to Date % (3)	Paid to Date (4)	Loss Reserve (5)	Reasonability Metrics: % of Premium (6)	Reasonability Metrics: Amount (7)	Reasonability Metrics: % Reserve (8)
1	100	75	65%	49	26	2.0%	2	8%
2	100	75	85%	64	11	1.3%	1	12%
3	100	75	90%	68	8	0.9%	1	12%
4	100	75	95%	71	4	0.6%	1	16%
5	100	75	100%	75	0	0.0%	0	
Sum	500	375		326	49		5	10%

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Illustration
Pick Current Year within 1% to get 5% reserve range

Years Since Inception	Premium (1)	Ultimate Loss (2)	Paid to Date % (3)	Paid to Date (4)	Loss Reserve (5)	Reasonability Metrics: % of Premium (6)	Reasonability Metrics: Amount (7)	Reasonability Metrics: % Reserve (8)
1	100	75	65%	49	26	1.0%	1	4%
2	100	75	85%	64	11	0.7%	1	6%
3	100	75	90%	68	8	0.4%	0	6%
4	100	75	95%	71	4	0.3%	0	8%
5	100	75	100%	75	0	0.0%	0	
Sum	500	375		326	49		2	5%

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Validating the Framework
(Our Laboratory Experiment)

Forming a view on each of the parameters:

- Degree of certainty for the current year loss pick
- Pattern of decrease in uncertainty (decrease in estimation risk, or increase in confidence) as the exposure period matures

What attributes of the book of business or elements of the reserve analysis would be part of your considerations?

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Degree of Certainty for the Current Year
Considerations

- Volume
- Homogeneity
- Expected payment & reporting patterns
- Claims operations (e.g., claims settlement, case reserving)
- Underwriting operations (e.g., classes, pricing, limits, deductibles)
- Current year "shock" losses (e.g., cats)

What else may be part of your considerations?

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Degree of Certainty for the Current Year
Testing Approach

- Gather Schedule P data from 10 companies for 3 lines
- Apply loss development with the Thomas Mack technique for evaluating the estimated standard error (ESE) of the ultimate loss estimate
- Blend the indications of the ESE from paid and reported development data
- Assume that the confidence in the current year pick is approximated by 1 ESE.
  - ❖ *See the Walker & Littmann paper & presentation on the topic of reasonable ranges and distributions of outcomes.*

There is no right answer to this question.

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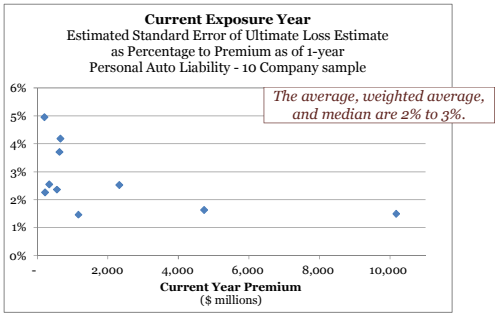
Testing – Personal Auto Liability
Estimated Standard Errors at Current Year-end



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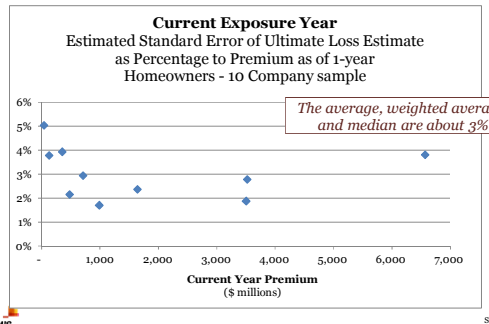
Testing – Homeowners
Estimated Standard Errors at Current Year-end



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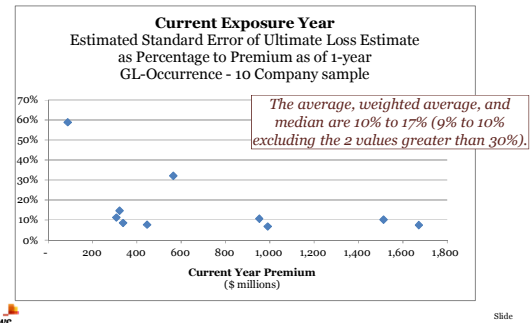
Testing – GL Occurrence
Estimated Standard Errors at Current Year-end



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How does Uncertainty Decrease as the Exposure Period Matures?

- Pro-rata as to time until last claim is paid?
- As unreported claim counts decrease?
- As unreported losses decrease?
- As unpaid losses decrease?
- As a combination of case reserves and IBNR?
- Something else?

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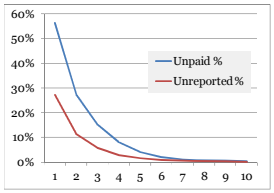
Hypothesis:
Uncertainty decreases as the portion of unpaid or unreported losses decreases

Years Since Inception	Paid to Date % (1)	Unpaid % (2)	Reported to Date % (1)	Unreported % (2)
1	44%	56%	73%	27%
2	73%	27%	89%	11%
3	85%	15%	94%	6%
4	92%	8%	97%	3%
5	96%	4%	98%	2%
6	98%	2%	99%	1%
7	99%	1%	99%	1%
8	99%	1%	100%	0%
9	99%	1%	100%	0%
10	100%	0%	100%	0%



Payment and reporting patterns based on industry personal auto liability data.

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Hypothesis:
Uncertainty decreases as a <u>combination</u> of IBNR <u>and</u> Case Reserves decreases

Years since Inception	Unpaid %	100% Unreported %	50% Case %	Combined
1	56%	27%	29%	42%
2	27%	11%	16%	19%
3	15%	6%	9%	11%
4	8%	3%	5%	6%
5	4%	2%	2%	3%
6	2%	1%	1%	1%
7	1%	1%	1%	1%
8	1%	0%	0%	1%
9	1%	0%	0%	0%
10	0%	0%	0%	0%

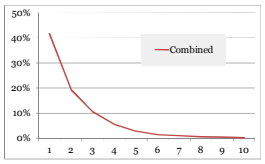

Illustration based on industry personal auto liability data.

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How does Uncertainty Decrease?
Testing Approach

- Gather Schedule P development histories for 10 companies for 3 lines
- Evaluate baseline loss payment and reporting patterns
- Apply the technique described by Dr. Thomas Mack for evaluating estimated standard errors (ESE's) of the ultimate loss estimates
- Observe the reduction (decay) in the ESE's as the exposure periods mature

There is no right answer to this question.

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Example – Estimated Standard Errors

Years since Inception	ESE based on Paid	ESE based on Reported	Weighted ESE	Ratio
	(1)	(2)	(3)	(4)
1	3.4%	2.1%	2.5%	1.00
2	2.3%	1.4%	1.7%	0.67
3	1.9%	0.3%	0.8%	0.32
4	0.4%	0.2%	0.3%	0.10
5	0.2%	0.1%	0.1%	0.05
6	0.1%	0.1%	0.1%	0.03
7	0.0%	0.1%	0.1%	0.02
8	0.0%	0.1%	0.1%	0.02
9	0.0%	0.0%	0.0%	0.01
10	0.0%	0.0%	0.0%	0.00

(1), (2): Based on sample data set. Expressed as percentage of premium.
(3): Based on 2:1 weighting on the ESE's based on Reported and Paid data.
(4): (3) / $(3)_{[1]}$

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Example – Unreported, Unpaid, and Combined Patterns (1/2)

			50%	100%			
Years since Inception	Paid %	Reported %	Case %	IBNR %	Combined Outstanding %	Unpaid %	Un-reported %
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	38%	67%	30%	33%	47%	62%	33%
2	70%	90%	20%	10%	20%	30%	10%
3	85%	96%	11%	4%	10%	15%	4%
4	92%	99%	7%	1%	5%	8%	1%
5	97%	100%	3%	0%	2%	3%	0%
6	99%	100%	1%	0%	1%	1%	0%
7	99%	100%	1%	0%	0%	1%	0%
8	100%	100%	0%	0%	0%	0%	0%
9	100%	100%	0%	0%	0%	0%	0%
10	100%	100%	0%	0%	0%	0%	0%

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Example – Unreported, Unpaid, and Combined Patterns (2/2)

				Ratio		
Years since Inception	Combined Outstanding %	Unpaid %	Un-reported %	Combined Outstanding %	Unpaid %	Un-reported %
	(5)	(6)	(7)	(8)	(9)	(10)
1	47%	62%	33%	1.00	1.00	1.00
2	20%	30%	10%	0.42	0.48	0.30
3	10%	15%	4%	0.20	0.24	0.13
4	5%	8%	1%	0.10	0.13	0.04
5	2%	3%	0%	0.04	0.06	0.01
6	1%	1%	0%	0.02	0.02	0.00
7	0%	1%	0%	0.01	0.01	0.00
8	0%	0%	0%	0.00	0.00	0.00
9	0%	0%	0%	0.00	0.00	0.00
10	0%	0%	0%	0.00	0.00	0.00

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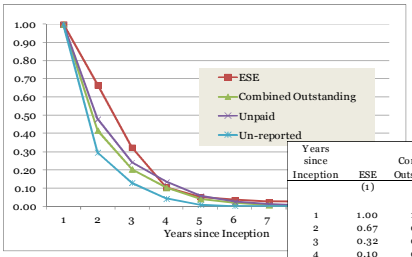
Example – Comparison of Decay Patterns



Years since Inception	ESE (1)	Combined Outstanding (2)	Unpaid (3)	Un-reported (4)
1	1.00	1.00	1.00	1.00
2	0.67	0.42	0.48	0.30
3	0.32	0.20	0.24	0.13
4	0.10	0.10	0.13	0.04
5	0.05	0.04	0.06	0.01
6	0.03	0.02	0.02	0.00
7	0.02	0.01	0.01	0.00
8	0.02	0.00	0.00	0.00
9	0.01	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00

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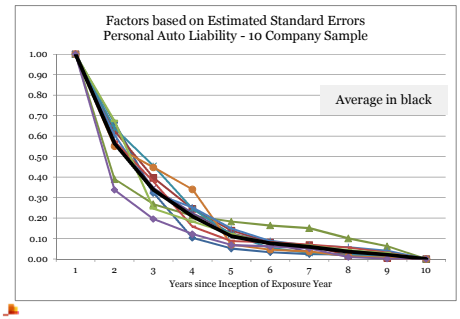
Testing – Personal Auto Liability
Decay Factors based on ESE's



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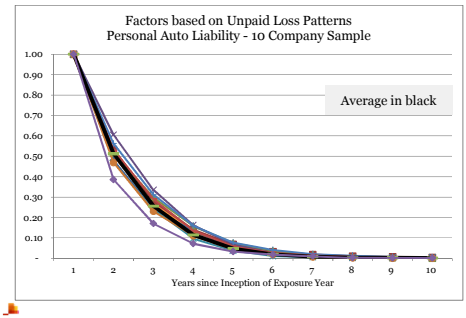
Testing – Personal Auto Liability
Decay Factors based on Unpaid Loss Patterns



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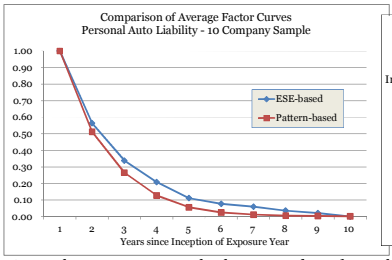
Testing – Personal Auto Liability
Comparison of Average Decay Factors



	Factor	
Years since Inception	ESE-based	Pattern-based
1	1.00	1.00
2	0.56	0.51
3	0.34	0.27
4	0.21	0.13
5	0.11	0.06
6	0.08	0.03
7	0.06	0.01
8	0.04	0.01
9	0.02	0.00
10	0.00	0.00

Across the 10 company sample, the average decay factors based on ESE's were 10% to 35% greater than the average factors based on the unpaid loss pattern.

- 10% to 50% higher based on the 50/100 case/IBNR pattern

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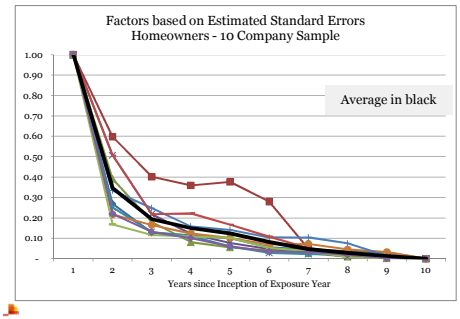
Testing – Homeowners
Decay Factors based on ESE's



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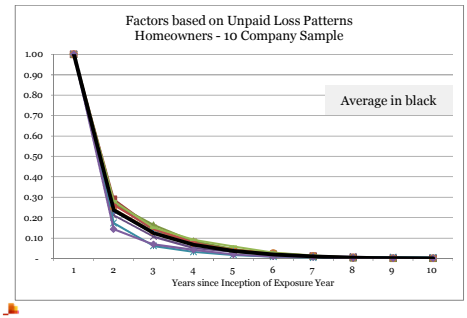
Testing – Homeowners
Decay Factors based on Unpaid Loss Patterns



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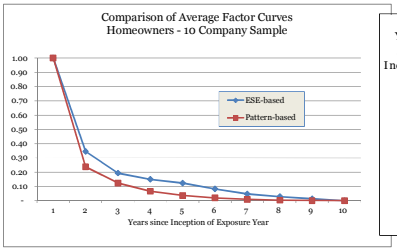
Testing – Homeowners
Comparison of Average Decay Factors



Years since Inception	Factor: ESE-based	Factor: Pattern-based
1	1.00	1.00
2	0.35	0.24
3	0.19	0.12
4	0.15	0.07
5	0.12	0.04
6	0.08	0.02
7	0.05	0.01
8	0.03	0.00
9	0.01	0.00
10	-	0.00

Across the 10 company sample, the average decay factors based on ESE's were 0% to 80% greater than the average factors based on the unpaid loss pattern.

- Relationships based on the 50/100 case/IBNR pattern were more volatile.

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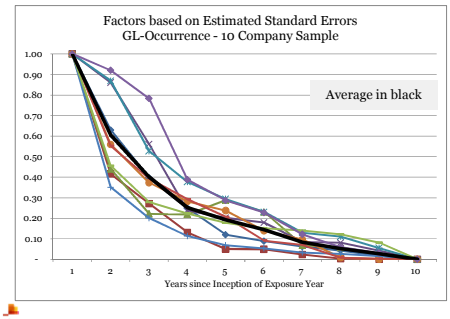
Testing – GL-Occurrence
Decay Factors based on ESE's



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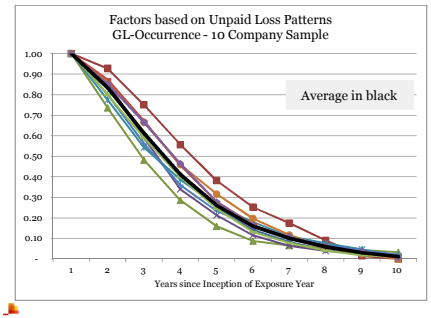
Testing – GL-Occurrence
Decay Factors based on Unpaid Loss Patterns



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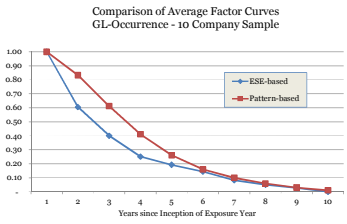
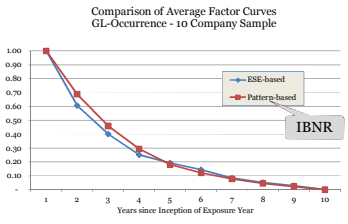
Testing – GL-Occurrence
Comparison of Average Decay Factors



Years since Inception	Factor: ESE-based	Factor: Pattern-based
1	1.00	1.00
2	0.61	0.83
3	0.40	0.61
4	0.25	0.41
5	0.19	0.26
6	0.14	0.16
7	0.08	0.10
8	0.05	0.06
9	0.03	0.03
10	-	0.01

Across the 10 company sample, the average decay factors based on ESE's were 15% less than to 5% greater than the average factors based on the unpaid loss pattern.

Testing – GL-Occurrence
Comparison of Average Decay Factors



Years since Inception	Factor: ESE-based	Factor: Pattern-based
1	1.00	1.00
2	0.61	0.69
3	0.40	0.46
4	0.25	0.29
5	0.19	0.18
6	0.14	0.12
7	0.08	0.08
8	0.05	0.04
9	0.03	0.02
10	-	-

Across the 10 company sample, the average decay factors based on ESE's were 10% less than to 10% greater than the average factors based on the IBNR loss pattern.

Testing – Observations

What have we observed about the degree of certainty (range of uncertainty) associated with the estimate for the current exposure period?

- For some lines, the ESE may be a reasonable indicator for the uncertainty associated with the current period's estimate.
- For other lines, it may not be; in these cases, sensitivity testing may yield better indications.
- The characteristics and conditions noted previously (reference slide 16) need to be considered in forming a view.

Testing – Observations

What have we observed about how the estimation risk decreases as the exposure period matures?

- Of the 3 development-based patterns (unpaid, unreported, and combined outstanding), the unpaid loss pattern drove the slowest reduction in uncertainty.
- For personal auto liability and homeowners, the average decay factors based on ESE's tended to be greater than the average factors based on the unpaid loss patterns.
- For GL-occurrence, the average decay factors based on ESE's tended to be less than the average factors based on the unpaid loss patterns, but were generally closer to the average factors based on the IBNR patterns.

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Testing – Observations

What about correlations among exposure periods?

- The Mack-based calculations assume a degree of independence among the exposure periods, so that the total ESE for all periods combined is less than the sum of the ESE's for each period.
  - The overall ESE tended to be 50% to 70% of the sum of the ESE's.
- For personal auto liability and homeowners, the average decay factors based on ESE's tended to be greater than the average factors based on the unpaid loss pattern.
  - 10% to 35% higher for Personal Auto Liability
  - 0% to 80% higher for Homeowners

Considering these "features" and for ease of calculations, we continue with examples based on reduction in uncertainty based on unpaid loss patterns and summing the periods' amounts.

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Back to our Framework

- Degree of certainty for the current year loss pick
- Pattern of increase in certainty (decrease in estimation risk) as the exposure period matures

						Reasonability Metrics		
Years Since Inception	Premium (1)	Ultimate Loss (2)	Paid to Date % (3)	Paid to Date (4)	Loss Reserve (5)	% of Premium (6)	Amount (7)	% Reserve (8)
1	100	75	65%	49	26	3.0%	3	11%
2	100	75	85%	64	11	2.0%	2	18%
3	100	75	90%	68	8	1.3%	1	18%
4	100	75	95%	71	4	0.9%	1	24%
5	100	75	100%	75	0	0.0%	0	
Sum	500	375		326	49		7	15%

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Industry Data – Personal Auto Liability

- Using historical industry data for premiums, ultimate losses, and loss payments
- 3% certainty for the current year
- Uncertainty decreases over time based on unpaid loss pattern

Years Since Inception	Premium (1)	Ultimate Loss (2)	Paid to Date % (3)	Paid to Date (4)	Loss Reserve (5)	Reasonability Metrics: % of Premium (6)	Reasonability Metrics: Amount (7)	Reasonability Metrics: % Reserve (8)
1	102	84	44%	37	47	3.0%	3	6.5%
2	99	80	73%	58	22	1.5%	1	6.6%
3	96	78	85%	66	12	0.8%	1	6.6%
4	94	76	92%	69	6	0.4%	0	6.7%
5	94	72	96%	69	3	0.2%	0	7.0%
Total					93		6	6.6%

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Industry Data – Homeowners

- Using historical industry data for premiums, ultimate losses, and loss payments
- 3% certainty for the current year
- Uncertainty decreases over time based on unpaid loss pattern

Years Since Inception	Premium (1)	Ultimate Loss (2)	Paid to Date % (3)	Paid to Date (4)	Loss Reserve (5)	Reasonability Metrics: % of Premium (6)	Reasonability Metrics: Amount (7)	Reasonability Metrics: % Reserve (8)
1	68	52	71%	37	15	3.0%	2	13.4%
2	65	60	94%	57	4	0.6%	0	11.2%
3	62	47	96%	45	2	0.4%	0	13.6%
4	59	45	98%	44	1	0.2%	0	13.4%
5	59	50	99%	50	1	0.1%	0	12.1%
Total					23		3	13.1%

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So, What does it Take to have a Reserves Range of plus/minus 5%?

Line	Current Year Range (% Premium)
Homeowners	1%
Personal Auto Liability	2%
GL – Occurrence *	3%

- Using historical industry data for premiums, ultimate losses, and loss payments
- Assuming uncertainty decreases over time based on unpaid loss pattern

* Using the IBNR loss pattern for GL-Occurrence, a 3% current year (loss ratio) range would drive a reserve range of 4%.

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So, What does it Take to have a Reserves Range of plus/minus 5%?

Line	Current Year Range (% Premium)
Homeowners	1%
Personal Auto Liability	2%
GL - Occurrence	3%
Commercial Auto Liability	3%
Commercial Multi-Peril	2%
Workers Compensation	3%

- Using historical industry data for premiums, ultimate losses, and loss payments
- Assuming uncertainty decreases over time based on unpaid losses

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Take-Away's

1. Expressions of reasonable reserve ranges may not reflect due consideration of the ability to estimate the current year ultimate loss and how the uncertainty decreases as exposure periods mature.
2. While short-tail lines may have greater certainty of the ultimate loss estimate as compared to long-tail lines, the uncertainty in relation of the unpaid losses may be greater for short-tail lines.
3. Know your portfolio before making a judgment on reasonable ranges – whether on an ultimate basis or a reserve basis.
4. Translating your reserve range in terms of your certainty of the current year pick and how the uncertainty decreases as loss periods mature may be useful for the variety of stakeholders who seek insights and opinions from you on your point-estimates and the associated reasonable range.

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Discussion

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