

# *Seminar on Reinsurance*

*June 5–6, 2023*

*Westin Philadelphia  
Philadelphia, PA*

# **I1: Intermediate Topics on Experience and Exposure Rating**

**CARe Seminar, June 5-6, 2023 – Philadelphia, PA**

**Yinglu Fan, FCAS, AVP Treaty Underwriter (Moderator)**

**John Maher, FCAS, Senior Vice President**

**Ralph Dweck, FCAS, Actuarial Director, Verisk/ISO**



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# Intermediate Track Pre-Requisites

*These presentations are considered intermediate level and assume you already have a basic understanding of the following concepts:*

- General purpose of exposure rating vs experience rating
- Losses occurring vs risks attaching
- Treaty vs facultative
- Excess of loss reinsurance
- Primary vs excess policies
- Claims development and trending/on-leveling: purpose and methodologies
- ALAE, rate change, ILFs, credibility

# I1: Intermediate Topics on Experience and Exposure Rating

This session will build upon basic CArE track and prior boot camp materials and will presuppose familiarity with the basics of experience and exposure rating methodologies. This session will include the usage of more advanced techniques to identify and address common excess rating challenges. These challenges have been exacerbated by the significant but waning pandemic disruptions and resulting supply constrained inflation impacts over the last 3 years. These additional techniques and distortions include:

- **Rating methods: Shifting policy limits, credibility and blending of loss development factors, and combining experience & exposure ratings**
- **Measuring benchmark distortions: LDFs, severities, frequencies, closure ratios, recent adverse development and resulting loss ratios**

Accurately assessing these impacts holistically, and avoiding overconfidence, will lead to more refined pricing/reserving benchmarking and individual account analysis.

## **Moderator:**

Yinglu Fan, FCAS, AVP Treaty Underwriter, QBE Re 5 mins *(1 intro slide + potential polls updates 2022)*

## **Panelists:**

John Maher, FCAS, Senior Vice President, QBE Re 25-30 mins *(27 slides)*

Ralph Dweck, FCAS, Actuarial Director, Verisk/ISO 25-30 mins *(26 slides)*

Q&A 10 mins





# Measuring Confidence – Covid/Inflation Trends- 6/2022

## 2022 CArE Seminar (CS10) - Measuring Actuarial Confidence

### 1. General Liability Average Annual Frequency Change from 2015 to 2019 (pre Covid)

Lower 90%  
Confidence Interval

Upper 90%  
Confidence Interval

### 2. General Liability Frequency Change from 2019 to 2020 (1st Covid year)

Lower 90%  
Confidence Interval

Upper 90%  
Confidence Interval

### 3. General Liability Frequency Change from 2020 to 2021 (2nd Covid year)

Lower 90%  
Confidence Interval

Upper 90%  
Confidence Interval

### 11. What is your name (Optional)

We asked 12 Qs (10 US, 2 UK) via Survey Monkey that was presented at the 2022 CArE Conference in a pair of linked sessions. The poll was left up during the course of the Monday June 13 CS10 2pm presentation. To answer the questions: **If you feel 90% of the time the answer will be between -15% to -5% then enter -15 and -5 in the 2 boxes.** Should **carefully** read the question being asked, such as LOB, frequency or severity, and time period.

You can answer either **anonymously**, or **provide your name** at the end. You don't need to answer all the Q's leaving certain ones blank or just providing a wider range on those. "Answers" will be presented during CS10s Covid/Inflation section.

Measuring Confidence answers, comparing aggregated confidence interval ranges to the "Answers", was provided in the 2022 **Tuesday linked session CS23 "Overinflated Wheels"**. That session will also go deeper into the Covid/Inflation impacts in the Commercial and Personal Auto poll Q results.



# ISO CARe 6/2022 Survey of Covid/Inflation Trends

Metrics for Pre Covid, 1 <sup>st</sup> Covid and 2 <sup>nd</sup> Covid year	90% CI (Responses)		"Actual"	Responses in Range
	Lower	Upper		
1. Total GL Frequency Change – 2015-2019	-10%	7%	-4.0%	33.0%
<b>2. Total GL Frequency Change – 2019-2020</b>	<b>-20%</b>	<b>5%</b>	<b>-29.5%</b>	<b>0.0%</b>
3. Total GL Frequency Change – 2020-2021	-10%	15%	-2.0%	33.0%
<b>4. Total GL Severity Change – 2015-2019</b>	<b>0%</b>	<b>15%</b>	<b>5.2%</b>	<b>82.0%</b>
5. Total GL Severity Change – 2019-2020	0%	20%	10.7%	27.0%
<b>6. Total GL Severity Change – 2020-2021</b>	<b>0%</b>	<b>20%</b>	<b>9.1%</b>	<b>91.0%</b>
<b>7. Total CAu Frequency Change – 2019-2020</b>	<b>-40%</b>	<b>20%</b>	<b>-26.3%</b>	<b>17.0%</b>
8. Total CAu Severity Change – 2020-2021	2%	20%	10.7%	45.0%
9. Total PAu Frequency Change – 2019-2020	-50%	2%	-22.5%	33.0%
10. Total PAu Severity Change – 2020-2021	2%	30%	7.5%	55.0%
11. UK Personal Motor Frequency Change – 2019-2020	-50%	10%		
12. UK Personal Motor Severity Change – 2020-2021	0%	20%		

*NB: Above frequency indications are Nominal, before rate change impacts*



# Shifting Limits in Excess of Loss Ratings



# Shifting Limits in Excess of Loss Rating

- **Changing Policy Limits Distribution**
  - Suppose we are pricing a 500,000 excess of 500,000 layer, but the ceding company has recently begun writing higher limit policies that result in more exposure to the layer.
  - Can we still use the historical experience rating?
  - If so, what adjustments can be made?

# Shifting Limits in Excess of Loss Rating

- There are many possible approaches to overlay an adjustment to the experience rating.
- One approach: Adjust historical experience period burn cost based on the relative exposure rating of each historical period (i.e. limits drift factor)
- Advantage:
  - This is one of the most accurate of possible methods.
- Disadvantage(s):
  - Requires full policy limit profile for each historical period
  - Potential difficulty in explaining adjustment factors

Example on the next slide...

# Shifting Limits in Excess of Loss Rating

Adjust historical experience period burn cost based on the relative exposure rating of each historical period (i.e. limits drift factor)

AY	<u>Policy Limit Distribution</u>			<u>Exposure Rate</u>	
	500,000	750,000	1,000,000	250,000 excess of	500,000 excess of
	500,000	750,000	1,000,000	250,000	500,000
2011	75.00%	20.00%	5.00%	14.88%	2.22%
2012	75.00%	20.00%	5.00%	14.88%	2.22%
2013	75.00%	20.00%	5.00%	14.88%	2.22%
2014	75.00%	20.00%	5.00%	14.88%	2.22%
2015	75.00%	20.00%	5.00%	14.88%	2.22%
2016	70.00%	20.00%	10.00%	14.82%	2.87%
2017	65.00%	20.00%	15.00%	14.76%	3.52%
2018	60.00%	20.00%	20.00%	14.70%	4.17%
2019	60.00%	20.00%	20.00%	14.70%	4.17%
2020	60.00%	20.00%	20.00%	14.70%	4.17%
2021	60.00%	20.00%	20.00%	14.70%	4.17%

- The exposure rates from this table are used to adjust the experience rated loss costs. The change in exposure rate combines the impact of the changing layered loss and the change in premium that results from the shift in the limits profile.

# Shifting Limits in Excess of Loss Rating

Adjust historical experience period burn cost based on the relative exposure rating of each historical period (i.e. limits drift factor)

AY	Limit	Prem Wgt	Expected Loss to 500K xs 500K Layer	Weighted Expected Loss	Limits Drift Factor
2011	500,000	75.0%	0.00%	2.22%	1.88
	750,000	20.0%	7.83%		
	1,000,000	5.0%	13.01%		
2021	500,000	60.0%	0.00%	4.17%	1.00
	750,000	20.0%	7.83%		
	1,000,000	20.0%	13.01%		

- Limits drift factor for 2011 = Expected Loss for 2020 / Expected Loss for 2011
  - $4.17\% / 2.22\% = 1.88$
- The experience rated loss cost indication for 2011 would then be adjusted by a factor of 1.88 to account for the fact that the ceding company is now writing more high limit policies than they have in the past.
- This adjustment factor would be calculated for each year in the experience period.
- **IMPORTANT – this methodology can be used for an increasing shift in limits or decreasing shift in limits**



	AY		Ultimate Loss Ratio		Exposure Indication \$500k Xs \$500k		Limits Drift Factor		Adjusted Ultimate Loss Ratio
	2011		2.8%		2.22%		1.88		5.2%
	2012		2.0%		2.22%		1.88		3.8%
	2013		1.4%		2.22%		1.88		2.6%
	2014		3.3%		2.22%		1.88		6.2%
	2015		4.0%		2.22%		1.88		7.5%
	2016		2.8%		2.87%		1.45		4.0%
	2017		3.4%		3.52%		1.18		4.0%
	2018		3.0%		4.17%		1.00		3.0%
	2019		2.7%		4.17%		1.00		2.7%
	2020		3.1%		4.17%		1.00		3.1%
	2021		4.1%		4.17%		1.00		4.1%
Straight Avg ==>			3.0%						4.2%

# Credibility in Loss Development



# The Issue

- The client data we get is usually not 100% credible, due to volume and insufficient time frame.
- We have some prior knowledge of what the development pattern should look like, either from external data or wider samples of similar business.
- How do we blend our prior knowledge with the new observation in a systematic way?

# Brief Introduction to Bayesian Credibility

- “Probability is orderly opinion, and inference from data is nothing other than the revision of such opinion in the light of relevant new information.” Edwards, Lindman and Savage
- Bayesian Theory

$$f(\theta|x) = \frac{f(x|\theta) \cdot f(\theta)}{f(x)} = \frac{f(x|\theta) \cdot f(\theta)}{\int_{\theta} f(x|\theta) \cdot f(\theta) d\theta}$$

# Bayesian Made Simple

Two coins are in a box: one with both sides heads and one fair coin.

- Select one coin at random and flip it, the odds of a heads are:

- $Prob(heads) = \frac{1}{2} \times 1 + \frac{1}{2} \times 0.5 = 0.75$

(one-half chance selecting the sure heads coin and one-half chance selecting the fair coin)

- The first result was heads. Now use the same coin and flip it a second time. The odds of a second heads are:

We need to first calculate the odds that each of the coins was initially selected, given the result of heads. These are called Conditional Probabilities.

1.  $Prob(heads \text{ only coin}) = \frac{0.5 \times 1}{0.75} = \frac{2}{3}$

2.  $Prob(fair \text{ coin}) = \frac{0.5 \times 0.5}{0.75} = \frac{1}{3}$

Finally, we use these conditional probabilities as weights and multiply them by the odds of a heads on those respective coins:

$$\frac{2}{3} \times 1 + \frac{1}{3} \times 0.5 = 0.83$$

# Application to Loss Development

- Organize the prior beliefs into an explicit distribution
- By staying in the context of conjugate (posterior distribution follows the same parametric form as the prior distribution) models, the blending of prior knowledge with new data can be done with very simple calculations.
- $Z \cdot A + (1 - Z) \cdot B$
- Can be derived from Bayes Theorem either by assuming that the number of claims follow a Bernoulli process, with a Beta prior distribution on the unknown parameter  $p$ , or a Poisson process, with a Gamma prior distribution on the unknown parameter  $m$ .

# Generalized Dirichlet Distribution

- First introduced in the context of biological science.
- Parameter set with alphas and betas
- Alphas proportional to incremental loss and betas proportional to cumulative loss.
- Different weights for each cumulative development age, making it a natural for the development triangle format.

- $ATA_{12-24} = \frac{\alpha_k + \beta_k}{B_k}$

- $ATA_d = \frac{\emptyset \cdot (\alpha_{k-d} + \beta_{k-d}) + \sum_{t=1}^k C_{t,d+1}}{\emptyset \cdot \beta_{k-d} + \sum_{t=1}^k C_{t,d}}$

- Bayesian theory assumes that an analyst working with a loss development triangle does not start as a “blank slate” with no idea of what a development pattern looks like. Instead, it assumes that the analyst comes with some “prior” expectation and is willing to change that prior belief on what is observed in the new data. (Clark 2016)
- Our prior knowledge, in this case of the industry or market development patterns, is used as though it had been previously observed data.
- There are two main sources of uncertainty in prior information (Parodi and Bonche 2010)
  - Market heterogeneity – the spread of different risks around some industry average
  - Estimation uncertainty – the industry average, though large, may still be of limited size
- As a result, we may choose to give the prior distribution more or less variance (and ultimately credibility) depending on how we view these sources of uncertainty.



## Prior Information

	12	24	36	48	60	72	84	96
Prior Pattern LDF's==>	21.950	7.787	3.946	2.512	1.842	1.558	1.415	1.315
% Reported ==>	4.6%	12.8%	25.3%	39.8%	54.3%	64.2%	70.7%	76.0%
ATA ==>	2.819	1.973	1.571	1.364	1.182	1.101	1.076	1.315
Alpha	2.6	2.0	1.5	1.1	0.6	0.4	0.3	1.0
Beta	1.4190	2.0	2.5	2.9	3.4	3.6	3.7	3.0
Alpha + Beta ( $\alpha+\beta$ )	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Variance/Mean Ratio ( $\theta$ )	1,000							
Col. 1	1,419	2,027	2,546	2,933	3,383	3,633	3,717	3,042
Col. 2	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000

- User judgmentally selects  $\alpha+\beta$  and  $\theta$ , the variance to mean ratio.
- $\alpha$  is  $\theta \times (1-1/ATA)$
- $\beta$  is  $(\alpha+\beta) - \alpha$
- Col. 1 is  $(\theta \times \beta)$
- Col. 2 is  $(\theta \times (\alpha+\beta))$

# Client Data (new observation)

	12	24	36	48	60	72	84	96
1990	73	262	469	528	536	591	604	606
1991	148	346	391	502	522	514	567	
1992	99	198	219	394	408	430		
1993	118	255	352	412	581			
1994	275	415	645	803				
1995	261	446	637					
1996	130	471						
1997	148							
Col. 1	1,104	1,922	2,076	1,836	1,466	1,105	604	
Col. 2	2,393	2,713	2,639	2,047	1,535	1,171	606	
Avg ATA	2.168	1.412	1.271	1.115	1.047	1.060	1.003	

# Combine the two for Credibility Weighting

## Prior Knowledge

Col. 1	1,419	2,027	2,546	2,933	3,383	3,633	3,717	3,042
Col. 2	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
<b>ATA</b>	<b>2.819</b>	<b>1.973</b>	<b>1.571</b>	<b>1.364</b>	<b>1.182</b>	<b>1.101</b>	<b>1.076</b>	<b>1.315</b>

## New Observation

Col. 1	1,104	1,922	2,076	1,836	1,466	1,105	604	
Col. 2	2,393	2,713	2,639	2,047	1,535	1,171	606	
<b>ATA</b>	<b>2.168</b>	<b>1.412</b>	<b>1.271</b>	<b>1.115</b>	<b>1.047</b>	<b>1.060</b>	<b>1.003</b>	

## Credibility Weighted

Col. 1	2,523	3,949	4,622	4,769	4,849	4,738	4,321	3,042
Col. 2	6,393	6,713	6,639	6,047	5,535	5,171	4,606	4,000
<b>New ATA</b>	<b>2.534</b>	<b>1.700</b>	<b>1.436</b>	<b>1.268</b>	<b>1.141</b>	<b>1.091</b>	<b>1.066</b>	<b>1.315</b>

## Prior Information (more weight to prior)

	12	24	36	48	60	72	84	96
Prior Pattern LDFs ==>	21.950	7.787	3.946	2.512	1.842	1.558	1.415	1.315
% Reported ==>	4.6%	12.8%	25.3%	39.8%	54.3%	64.2%	70.7%	76.0%
ATA ==>	2.819	1.973	1.571	1.364	1.182	1.101	1.076	1.315
Alpha	3.9	3.0	2.2	1.6	0.9	0.6	0.4	1.4
Beta	2.1286	3.0	3.8	4.4	5.1	5.4	5.6	4.6
Alpha + Beta ( $\alpha+\beta$ )	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Variance/Mean Ratio ( $\Theta$ )	5,000							
Col. 1	10,643	15,202	19,098	21,998	25,375	27,246	27,880	22,814
Col. 2	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
<u>Credibility Weighted</u>								
Col. 1	11,747	17,124	21,174	23,834	26,841	28,351	28,484	22,814
Col. 2	32,393	32,713	32,639	32,047	31,535	31,171	30,606	30,000
Avg ATA	2.758	1.910	1.541	1.345	1.175	1.099	1.075	1.315

- The higher selection for the parameters ( $\alpha+\beta$ ,  $\Theta$ ) result in more weight being given to the prior knowledge.

# Using a Library of Benchmark Patterns

Benchmark Loss Development Factors (LDF to Ultimate)

	12	24	36	48	60	72	84	96
Fast	14.014	4.93	2.607	1.759	1.406	1.263	1.191	1.155
Medium	21.95	7.787	3.946	2.512	1.842	1.558	1.415	1.315
Slow	49.24	15.86	7.407	4.163	2.706	2.057	1.75	1.567

- In this case, we have not just one, but three benchmark patterns. These may be based on reporting lag, settlement strategies, case reserving practices, etc.
- If we have no knowledge of our client's practices, we can start with giving each benchmark pattern equal weights.
- We perform the credibility weighting of our client's data with each of these three benchmarks. Then use their likelihood functions to update the weights.

# Example (Fast Pattern)

Fast Pattern	12	24	36	48	60	72	84	96	
LDF	14.014	4.930	2.607	1.759	1.406	1.263	1.191	1.155	
Pattern	7.14%	20.28%	38.36%	56.85%	71.12%	79.18%	83.96%	86.58%	
ATA	2.843	1.891	1.482	1.251	1.113	1.060	1.031	1.155	
Alpha	6.5	4.7	3.3	2.0	1.0	0.6	0.3	1.3	
Beta	3.5	5.3	6.7	8.0	9.0	9.4	9.7	8.7	
Alpha+Beta	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Variance/Mean Ratio		1,000							
Col. 1	3,518	5,288	6,747	7,993	8,983	9,430	9,698	8,658	
Col. 2	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	
Blended ATA	2.681	1.763	1.432	1.226	1.104	1.060	1.030	1.155	
LDF	11.554	4.309	2.444	1.706	1.392	1.261	1.189	1.155	
Loglikelihood	-0.9363	-1.0052	-0.8252	-0.5260	-0.2687	-0.2535	-0.0290	0.0000	-3.8441



# Posterior Weights

## Bayesian Updating of Probabilities

	Log-Likelihood A	Difference in LL $B = B - \max(A)$	Relative Likelihood $C = \exp(B)$	Original Weights D	Revised Weights $E = C * D / \text{Avg}(C)$
Fast	-3.84	0	1.00	33.33%	43.98%
Medium	-4.06	-0.21	0.81	33.33%	35.61%
Slow	-4.61	-0.77	0.464	33.33%	20.41%

# Credibility In Loss Development

## 1. Sample Company Data

400K xs 100K Reported Loss Triangle

	12	24	36	48	60	72	84	96	ITD
2014	14,700	462,500	1,082,700	1,675,200	2,156,100	2,458,500	3,347,000	4,296,200	4,296,200
2015	196,900	1,033,300	1,758,900	2,517,000	3,455,800	3,891,300	4,423,300		4,423,300
2016	275,800	946,400	1,738,400	1,956,200	2,077,100	2,383,000			2,383,000
2017	215,700	527,800	1,192,300	2,126,000	2,009,200				2,009,200
2018	332,100	1,447,500	2,562,800	3,170,400					3,170,400
2019	284,800	1,141,400	1,758,600						1,758,600
2020	132,800	262,100							262,100
2021	20,100								20,100

Age-to-Age (ATA) Factors

	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96
2014	31.463	2.341	1.547	1.287	1.140	1.361	1.284
2015	5.248	1.702	1.431	1.373	1.126	1.137	
2016	3.431	1.837	1.125	1.062	1.147		
2017	2.447	2.259	1.783	0.945			
2018	4.359	1.771	1.237				
2019	4.008	1.541					
2020	1.974						
Avg	4.007	1.816	1.373	1.172	1.136	1.224	1.284

500K xs 500K Reported Loss Triangle

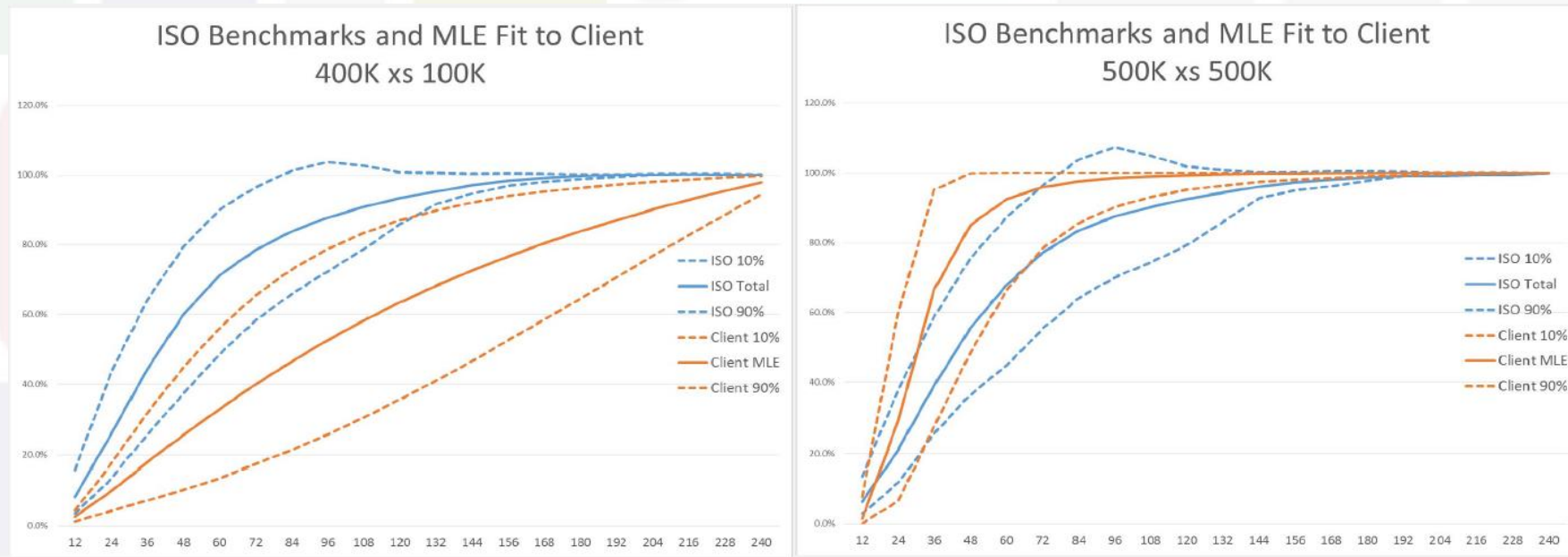
	12	24	36	48	60	72	84	96	ITD
2014	0	322,700	537,600	431,700	450,900	468,000	468,000	468,000	468,000
2015	0	27,200	27,200	0	185,700	371,400	371,400		371,400
2016	183,300	422,700	419,500	603,500	604,200	361,700			361,700
2017	0	0	315,300	605,100	531,900				531,900
2018	0	60,600	463,600	678,500					678,500
2019	0	65,500	482,900						482,900
2020	0	0							0
2021	0								0

Age-to-Age (ATA) Factors

	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96
2014	#DIV/0!	1.666	0.803	1.044	1.038	1.000	1.000
2015	#DIV/0!	1.000	0.000	#DIV/0!	2.000	1.000	
2016	2.306	0.992	1.439	1.001	0.599		
2017	#DIV/0!	#DIV/0!	1.919	0.879			
2018	#DIV/0!	7.650	1.464				
2019	#DIV/0!	7.373					
2020	#DIV/0!						
Avg	4.903	2.499	1.315	1.081	0.968	1.000	1.000

- First step would be to check for stability in the profiles and policy limit drift.
- Triangle observations:
  - The lower attaching 400K xs 100K layer has a far more credible triangle than the 500K xs 500K layer.
  - The empirical tail factor generated by the 400K xs 100K layer also significantly longer than the empirical tail factor in the 500K xs 500K triangle.

# Credibility In Loss Development



## 400K x 100K graph

- The blue lines represent an approximate 90% confidence interval around the industry pattern.
- Similarly, we can fit the client data to a curve to see a similarly calculated 90% confidence interval in orange above.
- The client data has a slower development pattern than the industry data.

## 500K x 500K graph

- The client data has a faster development pattern than the industry data.

## Application

The credibility weighted patterns are simply the dollar weighted average (utilizing the column 1 and column 2 figures) of the client / benchmark sections.

### 400K xs 100K Reported Loss Triangle

	12	24	36	48	60	72	84	96	ITD
2014	14,700	462,500	1,082,700	1,675,200	2,156,100	2,458,500	3,347,000	4,296,200	4,296,200
2015	196,900	1,033,300	1,758,900	2,517,000	3,455,800	3,891,300	4,423,300		4,423,300
2016	275,800	946,400	1,738,400	1,956,200	2,077,100	2,383,000			2,383,000
2017	215,700	527,800	1,192,300	2,126,000	2,009,200				2,009,200
2018	332,100	1,447,500	2,562,800	3,170,400					3,170,400
2019	284,800	1,141,400	1,758,600						1,758,600
2020	132,800	262,100							262,100
2021	20,100								20,100

### Client Pattern

	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - Ult
Column 1	1,452,800	5,558,900	8,335,100	8,274,400	7,689,000	6,349,800	3,347,000	
Column 2	5,821,000	10,093,700	11,444,800	9,698,200	8,732,800	7,770,300	4,296,200	
All Year Wtd ATA	4.007	1.816	1.373	1.172	1.136	1.224	1.284	

### Benchmark (Medium)

Column 1	3,166,052	5,845,636	7,385,911	8,416,317	9,080,542	9,364,207	9,547,360	8,779,631
Column 2	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000
ATA	3.159	1.711	1.354	1.188	1.101	1.068	1.047	1.139

### Credibility-Weighted

Column 1	4,618,852	11,404,536	15,721,011	16,690,717	16,769,542	15,714,007	12,894,360	8,779,631
Column 2	15,821,000	20,093,700	21,444,800	19,698,200	18,732,800	17,770,300	14,296,200	10,000,000
ATA	3.425	1.762	1.364	1.180	1.117	1.131	1.109	1.139
LDF to Ult	15.499	4.525	2.568	1.883	1.595	1.428	1.263	1.139



## Application

The same procedure is performed with the Slow and Fast benchmark patterns (Slow shown below).

### 400K xs 100K Reported Loss Triangle

	12	24	36	48	60	72	84	96	ITD
2014	14,700	462,500	1,082,700	1,675,200	2,156,100	2,458,500	3,347,000	4,296,200	4,296,200
2015	196,900	1,033,300	1,758,900	2,517,000	3,455,800	3,891,300	4,423,300		4,423,300
2016	275,800	946,400	1,738,400	1,956,200	2,077,100	2,383,000			2,383,000
2017	215,700	527,800	1,192,300	2,126,000	2,009,200				2,009,200
2018	332,100	1,447,500	2,562,800	3,170,400					3,170,400
2019	284,800	1,141,400	1,758,600						1,758,600
2020	132,800	262,100							262,100
2021	20,100								20,100

	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - Ult
<b>Client Pattern</b>								
Column 1	1,452,800	5,558,900	8,335,100	8,274,400	7,689,000	6,349,800	3,347,000	
Column 2	5,821,000	10,093,700	11,444,800	9,698,200	8,732,800	7,770,300	4,296,200	
All Year Wtd ATA	4.007	1.816	1.373	1.172	1.136	1.224	1.284	

### Benchmark (Slow)

Column 1	2,695,053	5,274,099	6,893,431	7,865,311	8,562,197	8,968,553	9,214,586	7,610,350
Column 2	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000
ATA	3.711	1.896	1.451	1.271	1.168	1.115	1.085	1.314

### Credibility-Weighted

Column 1	4,147,853	10,832,999	15,228,531	16,139,711	16,251,197	15,318,353	12,561,586	7,610,350
Column 2	15,821,000	20,093,700	21,444,800	19,698,200	18,732,800	17,770,300	14,296,200	10,000,000
ATA	3.814	1.855	1.408	1.220	1.153	1.160	1.138	1.314
LDF to Ult	24.316	6.375	3.437	2.441	2.000	1.735	1.495	1.314



## Application

Our prior weights (33.33%) are adjusted to posterior weights to reflect the fact that the client data is most representative of the slow curve.

### Bayesian Updating of Probabilities

	LogLikelihood	Difference in LogLikelihood	Relative Likelihood	Original Weights	Revised Weights
	A	B = A - Max(A)	C = exp(B)	D	E = C * D / Avg (C)
Fast	-22.7256	-6.1971	0.002	33.33%	0.18%
Medium	-18.5356	-2.0071	0.134	33.33%	11.82%
Slow	-16.5285	0	1.000	33.33%	87.99%
		Avg:	0.379		

The final pattern is a credibility-weighted average of the individual benchmark patterns weighted with the client data.

### Benchmark Loss Development Factors (LDF to Ultimate) - 400K xs 100K

	12	24	36	48	60	72	84	96	108	120	A Posteriori Weights
Fast	11.274	3.507	2.101	1.591	1.366	1.240	1.113	1.028	1.019	1.013	0.18%
Medium	15.499	4.525	2.568	1.883	1.595	1.428	1.263	1.139	1.101	1.073	11.82%
Slow	24.316	6.375	3.437	2.441	2.000	1.735	1.495	1.314	1.226	1.149	87.99%
Average	22.741	6.073	3.301	2.356	1.940	1.691	1.463	1.290	1.209	1.139	
Original Average	11.720	3.774	2.265	1.691	1.423	1.285	1.201	1.149	1.109	1.076	





## Application

- Same process is followed for the 500K xs 500K layer. However, now we can use what we learned on the 400K xs 100K layer and begin with our apriori weights equal to the posterior weights from the previous slide.
- Since the 500K xs 500K triangle has limited credibility, we would utilize a larger scale parameter which will result in a final pattern that is close to the “slow” benchmark.

Benchmark Loss Development Factors (LDF to Ultimate) - 500K xs 500K											
	12	24	36	48	60	72	84	96	108	120	A Posteriori Weights
Fast	9.909	3.242	1.866	1.399	1.203	1.084	1.038	1.025	1.020	1.015	0.16%
Medium	16.705	4.811	2.474	1.760	1.462	1.286	1.195	1.143	1.109	1.081	12.81%
Slow	33.051	7.635	3.480	2.416	1.965	1.638	1.454	1.343	1.267	1.201	87.03%
Average	29.272	7.087	3.303	2.303	1.880	1.581	1.414	1.313	1.244	1.184	

## Experience Rating (400K xs 100K)

- Utilizes the credibility weighted LDFs.
- Also makes use of any limits drift adjustment.

### Experience Rating \$400K xs \$100K layer

AY	On-Level Premium	Exposure Trend	Trended OLP	LDF	Premium / LDF	400K xs 100K Reported	Severity Trend	Frequency Trend	Policy Limit Drift*	400K xs 100K Trended	Rate
2014	18,432,700	1.083	19,959,973	1.290	15,472,235	4,296,200	1.267	1.000	0.995	5,415,086	35.0%
2015	17,258,900	1.072	18,503,877	1.463	12,649,328	4,423,300	1.230	1.000	0.995	5,412,901	42.8%
2016	17,916,600	1.062	19,018,832	1.691	11,248,161	2,383,000	1.194	1.000	0.996	2,834,045	25.2%
2017	18,544,100	1.051	19,490,035	1.940	10,045,621	2,009,200	1.159	1.000	0.997	2,322,226	23.1%
2018	18,470,700	1.041	19,220,684	2.356	8,157,962	3,170,400	1.126	1.000	0.998	3,561,177	43.7%
2019	19,199,500	1.030	19,781,264	3.301	5,991,728	1,758,600	1.093	1.000	0.998	1,917,826	32.0%
2020	19,157,800	1.020	19,542,872	6.073	3,217,946	262,100	1.061	1.000	0.999	277,784	8.6%
2021	19,374,100	1.010	19,567,841	22.741	860,450	20,100	1.030	1.000	1.000	20,703	2.4%
Total	148,354,400		155,085,378		67,643,430	18,322,900				21,761,747	32.2%
Prospective	20,000,000									6,434,253	32.2%

\* Calculation as discussed in Part 1 of the presentation

## Experience Rating (500K xs 500K)

- For the higher 500K xs 500K layer, the experience is volatile and not fully credible. In this case, the experience indication is credibility weighted with an exposure rated relativity selection.

Experience Rating \$500K xs \$500K layer

	On-Level	Exposure	Trended		Premium /	500K xs 500K	Severity	Frequency	Policy	400K xs 100K	
AY	Premium	Trend	OLP	LDF	LDF	Reported	Trend	Trend	Limit Drift	Trended	Rate
2014	18,432,700	1.083	19,959,973	1.313	15,202,738	468,000	1.267	1.000	1.037	614,784	4.0%
2015	17,258,900	1.072	18,503,877	1.414	13,087,677	371,400	1.230	1.000	1.033	471,849	3.6%
2016	17,916,600	1.062	19,018,832	1.581	12,027,621	361,700	1.194	1.000	1.025	442,686	3.7%
2017	18,544,100	1.051	19,490,035	1.880	10,365,785	531,900	1.159	1.000	1.020	628,950	6.1%
2018	18,470,700	1.041	19,220,684	2.303	8,344,685	678,500	1.126	1.000	1.016	775,876	9.3%
2019	19,199,500	1.030	19,781,264	3.303	5,988,227	482,900	1.093	1.000	1.012	534,010	8.9%
2020	19,157,800	1.020	19,542,872	7.087	2,757,660	0	1.061	1.000	1.004	0	0.0%
2021	19,374,100	1.010	19,567,841	29.272	668,474	0	1.030	1.000	1.000	0	0.0%
Total	148,354,400		155,085,378		68,442,867	2,894,400				3,468,155	5.1%
Prospective	20,000,000									1,013,445	5.1%
									400K xs 100K Rate		32.2%
									Exposure Rating Relativity		0.461
									Expected 500K xs 500K Rate		14.8%
									Credibility		75%
									Selected 500K xs 500K Rate		7.5%
									Selected 500K xs 500K Expected Loss		1,501,632

# **Measuring Benchmark Distortions: Three Year Pandemic and Heightened Inflation View**

# Measuring Benchmark Distortions: Three Year Pandemic and Heightened Inflation View

## Agenda

### **A. Benchmarking analysis framework**

- Benchmarking components
- External forces disruptions – pandemic 2020, inflation impacts 2021-22
- Assessing confidence and avoiding overconfidence

### **B. Tools to assess the disruption**

- Frequencies with on-level premium
- Average reportings and settlements
- Loss development factors – pre/during pandemic
- Closure ratios
- Adverse development - ex ante

### **C. Impact Analysis – Experience through 12/31/2022**

- Holistic view: frequencies, severities, loss ratios – focus on GL
- Impact on Commercial Lines
- Where to now?



# A. Benchmarking Framework

- **Trends**
  - Severities, frequencies, exposures
  - Ground-up and Excess
- **Loss Development Factors**
  - Reporting and payment patterns
  - Closure ratios
- **Rate Changes**
- **Loss Costs**
  - Ground-up and ILFs
- **State / Hazard / Class Differentiations**
- ➔ • **External forces – disruptions**
- **Resulting expected loss ratios**

**Goal: Confident entry / exit decisions,  
anticipating competitive market cycle changes**

# Benchmark Assessment Matrix

## Estimating Confidences – Pre-Pandemic - Illustrative

As part of an annual or quarterly Best Practices framework, after gathering all relevant internal and external information, it is useful to assess all actuarial benchmarking components. And how confident you are in each.

Some for example like LDFs and rate changes may feel quite confident, if no major disruptions. While others like ILFs may feel less confident in times of high and unknown social inflation and litigation financing impacts.

	1	2	3	4	5	6	7	8
	Trends						State/ Hazard/ Subline	
	Ground Up			Excess		Loss Dev't Factors		
	Severity	Frequency	Exposure	Severity	Frequency	Ground Up		Excess
Casualty	●	⊙	●	⊙	⊙	●	●	⊙
Property	●	⊙	⊙	⊙	⊙	●	●	⊙
Specialty	●	⊙	○	⊙	⊙	⊙	⊙	⊙
	9	10	11	12	13	14	15	16
	Rate Changes		Loss Costs		External Forces	Loss Ratios		Where In the Cycle?
	Primary	Reinsurance	Ground-up	ILFs		Primary	Reinsurance	
Casualty	●	●	●	⊙	○	●	●	●
Property	●	●	●	⊙	○	●	●	⊙
Specialty	⊙	⊙	⊙	⊙	○	⊙	⊙	⊙
Confidence:	Good	●	Medium	⊙	Some	⊙	Minimal	○



# Pandemic and Inflation Impact: Questions

- What are the **base-line** expectations?
- How much have they been **distorted**?
- What does the **recovery shape** look like?
- What are the **expectations** for 2023/24?
- How **confident** are we in this assessment?

## B. Tools to assess the disruption

- **Review loss and premium triangles**
  - Calendar / accident quarter
- **Loss development factor distortions**
  - Distorted diagonals
- **Frequency ratios**
- **Average severities**
- **Closure ratios**
  - Cumulative, available to be closed, incremental
- **Adverse development - ex ante**

# Total General Liability – Raw Data Triangles

Illustrative

Reviewing overall GL triangles, focusing on pre and post Covid onset, can see even with relatively stable and increasing premium base, that claim counts are way down, but severities at a heightened level. Both significantly higher than longer term trends.

Losses evaluated through 12/31/2022							
General Liability							
Subline	(All)	PremOps	Products	Other			
Values	Loss Year	Loss Month	Evaluation Period	3	6	9	12
1 # Incurred Claims (I+A)	2017	3		28,485	33,899	32,642	31,748
	2017	6		30,922	37,756	35,810	35,167
	2017	9		31,913	37,039	35,787	35,359
	2017	12		26,097	32,249	31,166	30,682
	2018	3		30,454	35,428	33,804	33,138
	2022	6		19,197	24,982	24,014	
	2022	9		19,709	24,828		
	2022	12		15,099			
2 # Closed Claims (I+A)	2017	3		4,610	11,981	15,811	18,229
	2017	6		6,455	15,060	19,442	21,913
	2017	9		6,675	15,099	19,306	21,924
	2017	12		4,505	11,617	15,311	17,495
	2018	3		4,641	11,949	15,497	18,167
	2022	6		3,715	9,200	12,035	
	2022	9		3,866	9,168		
	2022	12		2,534			
8 Average Paid Indemnity	2017	3		2,972	4,612	5,488	6,883
	2017	6		2,722	3,977	5,330	6,586
	2017	9		3,293	4,341	5,359	6,641
	2017	12		3,346	4,186	5,545	6,874
	2018	3		3,007	4,152	5,562	7,212
	2022	6		4,140	6,056	8,319	
	2022	9		4,645	6,644		
	2022	12		4,779			
10 Average Outstanding	2017	3		10,016	21,251	34,797	50,666
	2017	6		8,922	19,210	33,984	47,734
	2017	9		9,566	20,093	34,176	48,783
	2017	12		9,183	20,360	35,080	51,136
	2018	3		9,985	22,505	36,576	55,197
	2022	6		12,415	27,835	47,808	
	2022	9		12,890	28,371		
	2022	12		13,806			
11 Earned Premium	2017	3		2,781,004,204	2,809,170,105	2,829,429,649	2,855,953,604
	2017	6		2,792,717,475	2,825,305,669	2,852,204,084	2,872,578,896
	2017	9		2,808,584,694	2,841,544,310	2,864,732,241	2,895,677,024
	2017	12		2,821,749,786	2,847,545,647	2,878,428,747	2,912,486,170
	2018	3		2,842,191,888	2,861,973,117	2,892,276,639	2,910,103,157
	2022	6		3,225,943,873	3,287,253,704	3,344,781,990	
	2022	9		3,280,734,544	3,333,411,677		
	2022	12		3,337,263,322			

Source: GL SOLM-Qtr at 12/31/2022



# Total General Liability – Overall LDFs

Illustrative

Can see lengthening impact on total LDFs, including affecting most recent evaluation of all accident years. And affecting both total reporting and payment patterns.

But the story goes much deeper than impact on LDFs.

GL Reported Indemnity LDFs

	12	24	36	48	60
AY 2005	1.628	1.297	1.118	1.039	1.011
AY 2006	1.607	1.282	1.122	1.044	1.018
AY 2007	1.617	1.273	1.114	1.036	1.034
AY 2008	1.610	1.238	1.114	1.073	1.024
AY 2009	1.552	1.235	1.123	1.049	1.036
AY 2010	1.527	1.255	1.133	1.058	1.025
AY 2011	1.579	1.277	1.131	1.053	1.023
AY 2012	1.588	1.279	1.134	1.063	1.033
AY 2013	1.657	1.283	1.149	1.072	1.036
AY 2014	1.611	1.305	1.159	1.069	1.041
AY 2015	1.634	1.341	1.183	1.077	1.024
AY 2016	1.719	1.347	1.188	1.070	1.045
AY 2017	1.741	1.366	1.163	1.077	1.057
AY 2018	1.720	1.337	1.150	1.112	
AY 2019	1.742	1.300	1.200		
AY 2020	1.781	1.355			
AY 2021	1.816				



GL Paid Indemnity LDFs

	12	24	36	48	60
AY 2005	2.710	1.807	1.508	1.253	1.125
AY 2006	2.856	1.783	1.495	1.252	1.130
AY 2007	2.835	1.790	1.466	1.254	1.131
AY 2008	2.711	1.741	1.490	1.259	1.133
AY 2009	2.680	1.724	1.441	1.253	1.126
AY 2010	2.763	1.726	1.463	1.254	1.116
AY 2011	2.834	1.748	1.430	1.242	1.130
AY 2012	2.739	1.692	1.432	1.244	1.144
AY 2013	2.770	1.725	1.475	1.281	1.130
AY 2014	2.724	1.776	1.520	1.277	1.143
AY 2015	2.849	1.847	1.520	1.291	1.107
AY 2016	2.964	1.817	1.515	1.216	1.131
AY 2017	2.985	1.828	1.413	1.247	1.183
AY 2018	3.026	1.718	1.434	1.318	
AY 2019	2.910	1.721	1.496		
AY 2020	2.856	1.810			
AY 2021	3.145				



# Total General Liability – Frequency Ratios - OLEP

Illustrative

Losses evaluated through 12/31/2022

General Liability

Additional Calculated Analytics - Closure and Frequency

Subline PremOps | Products | Other

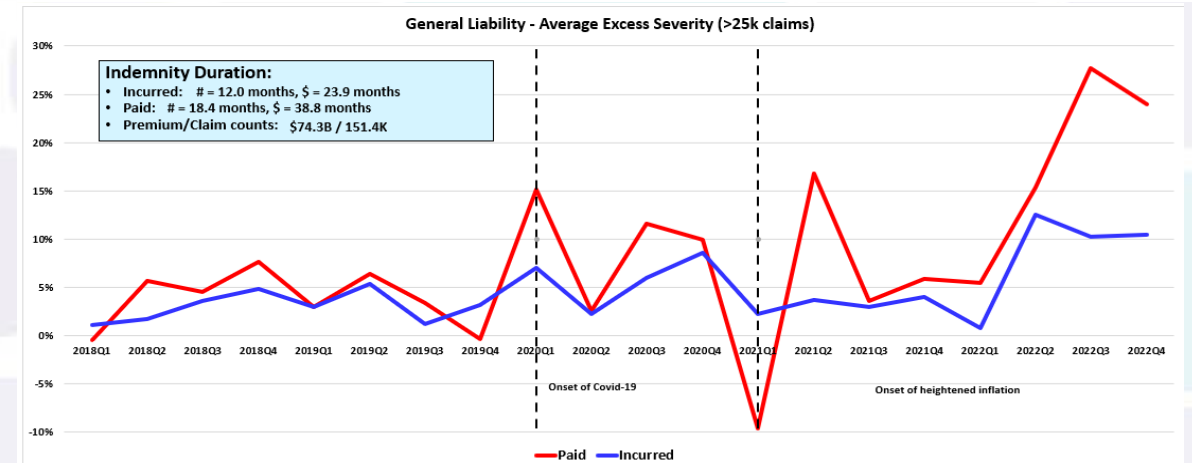
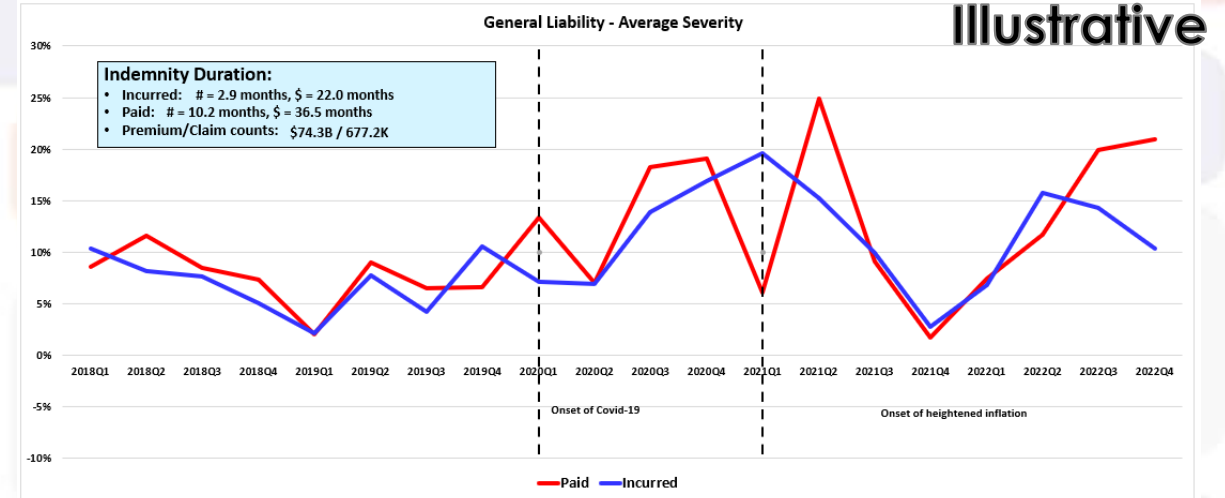
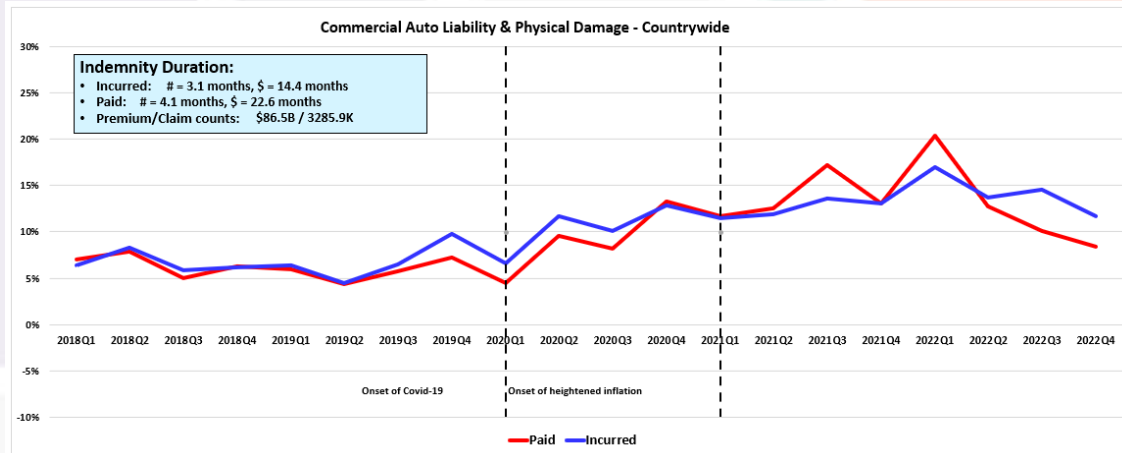
F. Incurred Counts / OLI = (1) / (11 \* OL Factor / 1000000)

		3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
2017	3	8.46	9.96	9.53	9.18	9.10	9.12	9.15	9.18	9.35	9.46	9.48	9.46	9.49	9.47	9.45	9.47
2017	6	9.09	10.97	10.30	10.05	9.96	9.97	9.92	10.00	10.18	10.26	10.23	10.25	10.26	10.28	10.29	10.28
2017	9	9.26	10.62	10.18	9.95	9.82	9.81	9.84	9.95	10.14	10.19	10.22	10.19	10.25	10.26	10.25	10.24
2017	12	7.51	9.19	8.79	8.55	8.43	8.43	8.44	8.53	8.68	8.74	8.71	8.74	8.78	8.79	8.79	8.78
2018	3	8.69	10.03	9.47	9.23	9.23	9.14	9.16	9.18	9.37	9.37	9.42	9.44	9.48	9.49	9.48	9.46
2018	6	8.29	10.32	9.80	9.66	9.51	9.56	9.55	9.62	9.70	9.82	9.82	9.83	9.87	9.87	9.87	9.86
2018	9	8.41	10.33	10.15	9.89	9.80	9.74	9.80	9.81	10.02	10.06	10.05	10.08	10.10	10.10	10.09	10.09
2018	12	6.77	8.87	8.56	8.40	8.31	8.31	8.27	8.37	8.49	8.54	8.55	8.56	8.59	8.59	8.57	8.58
2019	3	7.79	9.43	9.12	8.92	8.85	8.75	8.83	8.89	9.05	9.13	9.12	9.12	9.17	9.14	9.14	9.12
2019	6	6.98	9.17	9.11	8.95	8.81	8.84	8.83	8.89	9.07	9.10	9.12	9.13	9.16	9.18	9.16	
2019	9	7.53	9.70	9.33	9.12	9.15	9.11	9.12	9.22	9.33	9.39	9.41	9.39	9.41	9.42		
2019	12	6.60	8.26	7.86	7.82	7.74	7.73	7.76	7.78	7.93	7.99	7.99	8.01	8.03			
2020	3	5.93	6.67	6.53	6.44	6.43	6.48	6.46	6.51	6.64	6.67	6.68	6.69				
2020	6	4.27	5.71	5.55	5.57	5.57	5.57	5.59	5.64	5.70	5.75	5.75					
2020	9	5.83	7.06	7.06	7.05	6.96	6.93	6.97	7.01	7.11	7.14						
2020	12	4.61	6.10	6.01	5.93	5.85	5.83	5.85	5.92	5.99							
2021	3	5.35	6.73	6.53	6.37	6.29	6.25	6.30	6.33								
2021	6	5.59	7.20	6.91	6.80	6.70	6.69	6.69									
2021	9	5.87	7.17	6.97	6.87	6.80	6.73										
2021	12	4.76	6.12	6.00	5.86	5.70											
2022	3	5.51	7.04	6.80	6.53												
2022	6	5.73	7.32	6.91													
2022	9	5.89	7.31														
2022	12	4.52															

Even after on-leveling the premium used as an exposure base, the total ground-up frequencies remain significantly down, with no indicated reversal yet or reversion to normalcy through 12/31/2022. Would want to compare against any overall downward frequency trend including impacts of increasing deductibles and size of claim, before making any full assessments.

# Average Qtr Severity Trends YtY through 12/31/2022 – GL GU, XS 25k, CAu

Average severity trends are up significantly beyond normal long-term averages. For example, for Total GL, long term pre-pandemic severity trends were about 5.7% and about 7.7% since the start of the pandemic. Total CAu severity trends also increased by about 2% from before and after the start of the pandemic.



Subline: PremOps | Products | Other  
 Class Group: GL-Comp Op | GL-Contr | GL-CRR | GL-Ld Prd | GL-Liquor | GL-Mfg | GL-OLT | GL-Pollution | GL-Prod  
 Region: Midwest | North | South | West  
 Cause of Loss: All Causes of Loss  
 Claim Size: >=25k  
 Company Speed: Faster | Slower  
 Note: Using last 7 factors for Incurred LDF



# Total General Liability – Closure Ratios #1

Illustrative

Losses evaluated through 12/31/2022

General Liability

Additional Calculated Analytics - Closure and Frequency

A. Cumulative Closed

= 1. Closed Claims / 2. Incurred Claims

		3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
2017	3	16.2%	35.3%	48.4%	57.4%	63.2%	67.1%	70.1%	73.0%	74.9%	76.5%	78.5%	80.7%	82.7%	84.4%	86.3%	87.5%
2017	6	20.9%	39.9%	54.3%	62.3%	67.6%	71.2%	74.7%	76.9%	78.3%	79.6%	81.7%	83.2%	84.8%	86.0%	87.1%	88.3%
2017	9	20.9%	40.8%	53.9%	62.0%	67.5%	71.4%	74.1%	76.2%	77.5%	79.3%	80.8%	82.7%	83.7%	85.2%	86.6%	87.8%
2017	12	17.3%	36.0%	49.1%	57.0%	63.6%	67.6%	71.0%	73.1%	75.0%	76.7%	79.1%	80.7%	82.2%	83.5%	85.0%	86.5%
2018	3	15.2%	33.7%	45.8%	54.8%	60.2%	64.9%	68.1%	71.1%	72.8%	75.1%	76.8%	78.7%	80.3%	81.9%	83.7%	85.4%
2018	6	19.3%	37.6%	52.7%	60.7%	66.9%	70.6%	73.9%	76.0%	78.1%	79.2%	80.8%	82.2%	83.5%	85.1%	86.5%	87.9%
2018	9	18.5%	39.7%	52.6%	60.8%	66.2%	70.3%	72.9%	75.7%	76.7%	78.2%	79.9%	81.2%	82.9%	84.6%	86.1%	87.6%
2018	12	19.9%	38.2%	51.3%	59.2%	65.1%	69.0%	72.6%	74.2%	75.8%	77.4%	79.0%	80.6%	82.1%	83.7%	85.5%	87.1%
2019	3	16.1%	35.2%	47.6%	56.5%	62.2%	67.0%	69.6%	71.9%	73.4%	74.7%	76.8%	78.9%	80.5%	82.6%	84.5%	86.3%
2019	6	20.3%	39.7%	53.7%	61.4%	67.6%	70.8%	73.6%	75.6%	76.6%	78.4%	80.0%	81.6%	83.2%	84.7%	86.5%	
2019	9	20.5%	40.5%	53.6%	62.0%	66.7%	70.6%	73.2%	75.0%	77.0%	78.4%	80.0%	82.0%	83.7%	85.4%		
2019	12	18.1%	35.7%	49.0%	56.0%	62.0%	66.1%	68.9%	71.9%	73.4%	74.9%	77.2%	78.9%	80.8%			
2020	3	18.2%	36.8%	48.3%	56.3%	61.9%	65.6%	69.2%	71.6%	73.1%	75.2%	77.3%	79.4%				
2020	6	24.1%	42.9%	55.8%	62.6%	67.7%	70.8%	73.3%	75.1%	76.9%	78.3%	80.1%					
2020	9	23.1%	42.5%	54.0%	60.9%	66.0%	69.7%	72.3%	74.5%	76.1%	77.9%						
2020	12	21.3%	36.8%	48.2%	55.0%	60.7%	64.5%	67.5%	69.7%	71.7%							
2021	3	16.9%	33.9%	44.9%	52.5%	58.0%	62.1%	65.0%	67.6%								
2021	6	20.7%	38.4%	51.0%	58.7%	64.3%	68.0%	71.3%									
2021	9	20.1%	38.4%	50.6%	58.0%	63.4%	67.8%										
2021	12	18.2%	35.5%	47.1%	55.1%	61.0%											
2022	3	15.2%	31.5%	42.7%	51.2%												
2022	6	19.4%	36.8%	50.1%													
2022	9	19.6%	36.9%														
2022	12	16.8%															

Reviewing a standard closure analysis of cumulative closed to incurred claims, indicates that there still remains slower than average settlements. Catchup to more normal levels has not yet occurred.



# Total General Liability – Closure Ratios #2

Illustrative

Losses evaluated through 12/31/2022

General Liability

Additional Calculated Analytics - Closure and Frequency

B. Closed/Available to be closed = (2 incremental) / (1 - 2@3 mo prior)

		3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
2017	3	16.2%	25.2%	18.5%	15.2%	13.1%	10.7%	10.1%	10.3%	11.4%	9.5%	9.1%	9.8%	11.2%	9.3%	10.9%	9.9%
2017	6	20.9%	27.5%	21.1%	15.7%	14.3%	11.3%	11.1%	10.9%	11.2%	8.4%	9.9%	9.1%	10.0%	8.9%	8.9%	8.9%
2017	9	20.9%	27.7%	20.3%	16.3%	14.2%	12.1%	10.6%	10.7%	10.9%	9.7%	8.5%	8.9%	8.5%	9.4%	9.0%	8.4%
2017	12	17.3%	25.6%	18.9%	14.2%	14.4%	11.7%	11.0%	9.7%	11.3%	8.7%	9.3%	8.8%	9.5%	8.0%	8.7%	9.7%
2018	3	15.2%	23.7%	16.2%	15.1%	12.7%	11.1%	9.6%	9.9%	10.3%	8.4%	8.3%	8.8%	9.1%	8.6%	9.5%	9.9%
2018	6	19.3%	26.3%	22.1%	16.3%	14.7%	11.5%	11.4%	9.9%	11.1%	9.0%	7.6%	7.7%	9.1%	9.3%	9.8%	10.1%
2018	9	18.5%	29.1%	20.9%	15.7%	13.8%	12.1%	10.3%	10.2%	10.1%	7.8%	7.3%	8.1%	9.5%	9.8%	9.4%	10.7%
2018	12	19.9%	27.2%	19.8%	15.4%	14.3%	11.8%	10.5%	9.0%	9.6%	8.3%	7.6%	8.1%	9.4%	9.0%	10.2%	11.0%
2019	3	16.1%	25.3%	18.0%	15.9%	13.1%	11.3%	9.7%	9.1%	9.4%	7.5%	8.0%	9.3%	9.3%	10.0%	10.6%	10.8%
2019	6	20.3%	28.8%	23.3%	15.8%	14.3%	11.0%	9.7%	9.1%	10.2%	8.6%	8.2%	8.3%	10.4%	9.9%	10.5%	
2019	9	20.5%	29.3%	20.3%	16.2%	13.2%	11.1%	9.5%	9.1%	11.0%	8.4%	8.2%	9.2%	10.8%	10.5%		
2019	12	18.1%	24.9%	18.6%	13.6%	12.5%	10.7%	9.2%	9.9%	9.6%	7.7%	9.0%	8.4%	9.9%			
2020	3	18.2%	24.7%	17.1%	14.2%	12.5%	10.5%	9.8%	9.5%	9.3%	8.9%	8.7%	9.9%				
2020	6	24.1%	30.5%	21.0%	15.7%	13.9%	10.1%	9.0%	8.8%	10.2%	8.7%	8.2%					
2020	9	23.1%	29.1%	19.9%	15.1%	12.2%	10.6%	9.8%	9.2%	10.4%	8.6%						
2020	12	21.3%	24.8%	17.5%	12.5%	11.9%	9.9%	8.9%	9.3%	9.1%							
2021	3	16.9%	23.8%	15.6%	12.5%	11.3%	9.6%	9.2%	8.3%								
2021	6	20.7%	26.8%	19.0%	15.1%	13.1%	11.5%	10.7%									
2021	9	20.1%	26.5%	19.1%	14.8%	13.4%	11.8%										
2021	12	18.2%	25.0%	17.8%	14.4%	11.9%											
2022	3	15.2%	22.4%	15.6%	13.1%												
2022	6	19.4%	25.8%	19.1%													
2022	9	19.6%	25.3%														
2022	12	16.8%															

An alternative closure analysis of reviewing closed claims divided by available to be closed from prior quarter shows a similar pattern, but with a bit more catching up done in the earliest accident quarters to longer term averages.

# Total General Liability – Closure Ratios #3

Illustrative

Losses evaluated through 12/31/2022

General Liability

Additional Calculated Analytics - Closure and Frequency

Subline PremOps | Products | Other

H. Paid Indemnity Closure = (5 incremental) / AQ Ultimate Indemnity

% Reptd	Ultimate		3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	
85.0%	1,374,025,145	2017	3	1.5%	4.2%	2.6%	3.2%	3.2%	3.6%	3.9%	4.9%	3.7%	4.6%	5.0%	4.8%	5.6%	3.7%	3.8%	3.3%
81.2%	1,380,426,568	2017	6	1.8%	4.0%	3.6%	3.4%	3.3%	3.5%	3.7%	3.5%	4.8%	4.6%	5.2%	4.2%	3.9%	3.6%	3.3%	3.1%
80.0%	1,474,381,671	2017	9	2.1%	3.8%	3.0%	3.2%	3.3%	3.1%	3.7%	4.1%	4.6%	4.7%	4.3%	3.8%	4.3%	3.4%	3.1%	3.4%
75.3%	1,380,955,079	2017	12	1.6%	3.4%	3.2%	3.0%	3.4%	3.4%	4.7%	3.9%	4.9%	4.5%	4.2%	4.0%	4.0%	2.4%	3.3%	3.9%
72.4%	1,579,076,399	2018	3	1.4%	3.2%	2.9%	3.4%	3.2%	3.0%	3.9%	4.9%	4.5%	3.4%	3.8%	4.2%	2.9%	4.0%	4.0%	4.5%
70.9%	1,464,232,147	2018	6	1.6%	3.9%	3.7%	3.7%	3.6%	3.7%	4.3%	4.4%	3.9%	3.3%	3.7%	3.4%	4.3%	4.5%	3.9%	3.8%
67.3%	1,605,407,265	2018	9	1.5%	3.8%	2.9%	3.0%	3.0%	3.8%	3.4%	3.0%	5.1%	3.3%	3.4%	3.7%	4.3%	4.4%	4.1%	4.3%
63.1%	1,432,677,071	2018	12	1.5%	3.4%	3.2%	2.8%	3.2%	3.4%	4.0%	3.0%	4.2%	3.2%	3.7%	3.3%	5.1%	3.8%	5.0%	5.5%
57.7%	1,557,030,523	2019	3	1.4%	3.4%	3.0%	4.1%	3.0%	3.2%	3.6%	3.7%	3.4%	3.3%	3.9%	5.0%	4.5%	4.0%	4.4%	3.9%
55.6%	1,491,653,898	2019	6	1.5%	3.9%	3.2%	3.6%	3.4%	3.2%	3.3%	3.1%	3.9%	4.1%	4.1%	3.9%	4.8%	4.6%	5.1%	
51.7%	1,551,734,724	2019	9	1.8%	3.9%	3.5%	3.5%	3.3%	3.2%	3.0%	3.7%	4.6%	3.6%	3.8%	4.4%	4.0%			
44.1%	1,479,216,016	2019	12	1.5%	3.3%	3.3%	2.8%	3.3%	2.9%	3.1%	3.2%	3.6%	3.7%	4.4%	3.9%	5.1%			
42.5%	1,215,517,872	2020	3	1.9%	3.3%	2.8%	2.9%	3.0%	3.1%	3.3%	4.8%	3.8%	4.1%	4.9%	4.6%				
37.8%	976,038,867	2020	6	1.8%	4.8%	4.0%	3.0%	3.7%	3.0%	2.6%	2.4%	4.2%	4.0%	4.2%					
35.1%	1,292,125,523	2020	9	1.9%	3.6%	3.1%	2.8%	3.1%	3.6%	3.3%	4.1%	4.3%	5.2%						
27.9%	1,253,014,243	2020	12	1.5%	2.9%	2.8%	2.5%	3.5%	3.0%	3.1%	4.3%	4.2%							
22.3%	1,369,978,868	2021	3	1.3%	3.0%	2.9%	3.2%	2.8%	2.8%	2.9%	3.4%								
23.3%	1,341,633,568	2021	6	1.4%	3.4%	3.1%	4.1%	3.3%	4.0%	4.0%									
18.7%	1,418,448,614	2021	9	1.7%	3.5%	3.1%	3.0%	3.2%	4.3%										
13.6%	1,286,899,365	2021	12	1.3%	2.9%	2.8%	2.9%	3.6%											
9.5%	1,528,153,920	2022	3	1.1%	2.8%	2.6%	3.0%												
8.3%	1,553,324,794	2022	6	1.4%	3.5%	3.4%													
5.0%	1,600,273,299	2022	9	1.6%	3.4%														
1.3%	1,297,172,858	2022	12	1.3%															
	33,903,398,296																		

Note: Using last 7 factors for Incurred LDF No tail beyond 2017, Indemnity Only

This closure ratio, which requires triangulation estimates to ultimate and using that as a base, can see a bit more clearly the impact of the onset of Covid in 2020Q1 affecting most of the calendar quarters due to shutdown of claims activities and courts. Inventories are again starting to be cleared up.

## Commercial Auto - Paid Indemnity

**Cumulative Closed** = Closed Claims/ Incurred Claims

[illegible]

### Personal Auto - Paid Indemnity

**Cumulative Closed = Closed Claims / Incurred Claims**

		3	6	9	12	15	18	21	24	27	30
2017	3	48.7%	78.8%	87.1%	91.2%	93.5%	95.1%	96.1%	96.9%	97.7%	98.1%
2017	6	48.4%	78.1%	86.7%	91.0%	93.5%	95.0%	96.1%	96.9%	97.7%	98.1%
2017	9	47.5%	77.7%	86.5%	90.9%	93.4%	94.9%	96.0%	96.9%	97.6%	98.1%
2017	12	45.3%	77.2%	86.6%	90.9%	93.4%	94.9%	96.1%	96.9%	97.7%	98.1%
2018	3	48.2%	78.5%	87.0%	91.3%	93.6%	95.2%	96.1%	96.9%	97.7%	98.2%
2018	6	47.9%	78.2%	86.9%	91.1%	93.6%	95.0%	96.1%	96.9%	97.7%	98.0%
2018	9	45.4%	76.8%	86.1%	90.7%	93.2%	94.8%	95.9%	96.8%	97.5%	97.9%
2018	12	41.2%	75.3%	85.6%	90.3%	93.0%	94.7%	95.9%	96.7%	97.4%	97.9%
2019	3	43.3%	76.3%	85.9%	90.5%	93.2%	94.9%	95.9%	96.7%	97.4%	97.9%
2019	6	44.2%	76.7%	86.0%	90.6%	93.4%	94.8%	95.8%	96.5%	97.3%	97.8%
2019	9	45.7%	77.5%	86.8%	91.3%	93.5%	94.9%	95.9%	96.6%	97.5%	98.0%
2019	12	41.5%	76.5%	86.6%	90.7%	93.0%	94.5%	95.5%	96.5%	97.3%	97.7%
2020	3	49.1%	79.0%	87.3%	91.1%	93.3%	94.6%	95.9%	96.7%	97.3%	97.8%
2020	6	43.0%	77.6%	86.6%	90.5%	92.5%	94.7%	95.8%	96.4%	97.3%	97.8%
2020	9	45.1%	77.3%	85.9%	90.6%	92.9%	94.5%	95.3%	96.2%	97.1%	
2020	12	43.4%	75.9%	86.7%	90.8%	93.2%	94.4%	95.6%	96.4%		
2021	3	42.8%	79.0%	87.5%	91.2%	93.2%	94.7%	95.8%			
2021	6	39.7%	74.2%	84.8%	88.9%	91.8%	93.7%				
2021	9	37.1%	72.4%	83.6%	88.9%	91.8%					
2021	12	33.9%	71.4%	84.0%	89.1%						
2022	3	38.9%	73.4%	84.3%							
2022	6	38.4%	70.9%								
2022	9	37.7%									

[illegible]

**Source: CAu SOLM-Otr at 12/31/2022 & PAu SOLM-Otr at 9/30/2022**

## Calculating Ex-Ante – latest 7 qtr VWA

Incurred Indemnity	Loss Year	Loss Month	3	6	9	12
	2017	3	235,792,295	435,267,017	521,038,784	596,499,959
	2017	6	220,567,681	421,774,494	522,466,412	578,562,538
	2017	9	247,413,547	432,547,564	525,280,507	598,618,493
	2017	12	202,102,163	394,431,467	495,103,550	575,816,400
	2018	3	254,598,809	479,281,533	578,644,170	686,129,604
	2018	6	236,398,209	447,886,135	545,466,794	623,139,877
	2018	9	241,228,024	466,888,959	566,106,470	647,132,941
	2018	12	211,381,021	395,107,536	499,767,868	579,627,824
	2019	3	254,295,029	490,005,975	572,558,890	672,000,243
	2019	6	212,435,853	425,468,806	530,356,334	626,477,507
	2019	9	246,821,695	466,989,212	555,743,344	642,756,109
	2019	12	213,529,884	423,042,583	521,590,607	628,725,380
	2020	3	203,439,711	341,141,147	420,107,935	493,008,826
	2020	6	133,434,024	290,745,716	355,247,251	407,972,246
	2020	9	181,807,838	363,399,355	441,440,873	517,800,023
	2020	12	178,666,134	335,669,747	425,198,978	493,922,335
	2021	3	193,561,607	388,166,931	480,402,079	555,244,076
	2021	6	191,898,603	400,342,009	482,989,806	544,669,125
	2021	9	206,492,869	385,276,442	485,471,711	556,570,518
	2021	12	169,258,582	330,464,474	429,309,459	511,494,001
	2022	3	203,902,588	415,796,352	522,753,075	616,906,874
	2022	6	195,624,844	424,670,546	539,688,932	
	2022	9	210,001,292	442,774,601		
	2022	12	176,493,239			
			6/3	9/6		15/12
	2017	3	1.846	1.197	1.145	1.100
	2017	6	1.912	1.239	1.107	1.134
	2017	9	1.748	1.214	1.140	1.127
	2017	12	1.952	1.255	1.163	1.140
	2018	3	1.882	1.207	1.186	1.082
	2018	6	1.895	1.218	1.142	1.120
	2018	9	1.935	1.213	1.143	1.117
	2018	12	1.869	1.265	1.160	1.119
	2019	3	1.927	1.168	1.174	1.111
	2019	6	2.003	1.247	1.181	1.120
	2019	9	1.892	1.190	1.157	1.109
	2019	12	1.981	1.233	1.205	1.120
	2020	3	1.677	1.231	1.174	1.091
	2020	6	2.179	1.222	1.148	1.117
	2020	9	1.999	1.215	1.173	1.146
	2020	12	1.879	1.267	1.162	1.127
	2021	3	2.005	1.238	1.156	1.096
	2021	6	2.086	1.206	1.128	1.134
	2021	9	1.866	1.260	1.146	1.136
	2021	12	1.952	1.299	1.191	1.147
	2022	3	2.039	1.257	1.180	
	2022	6	2.171	1.271		
	2022	9	2.108			
			3 - 6	6 - 9	9 - 12	12 - 15
0	ATA	2017-2020Q1	1.886	1.220	1.160	1.114
0	ATA	2020Q2-2022Q3	2.026	1.248	1.161	1.129
1	ATA	Last 7 Quarters	2.034	1.256	1.162	1.129
	ATU		7.350	3.614	2.878	2.477
33,903,398,296	Ultimate		1,297,172,858	1,600,273,299	1,553,324,794	1,528,153,920
Duration: # of Months			1.5	4.5	7.5	10.5
22.0	% Reptd - Incr		13.6%	14.1%	7.1%	5.6%

PremOps | Products | Other  
GL-Comp Op | GL-Contr | GL-CRR | GL-Lcl Prd | GL-Liquor | GL-Mfg | GL-OLT | GL-Pollution | GL-Prod

Faster | Slower Midwest | North | South | West

All Causes of Los >=25k | 1 - <10k | 10k - <25k

Note: Using last 7 factors for Incurred LDF

1 Ex Ante

Estimated Ultimate	AQ	Actual n-1	Actual n	7-Yr ATA	Expected n	Actual - Expected
1,366,239,853	2017Q1	1,366,239,853	1,374,025,145	1.000	1,366,239,853	7,785,292
1,388,662,460	2017Q2	1,362,319,667	1,372,605,005	1.019	1,388,662,460	(16,057,455)
1,468,971,115	2017Q3	1,423,425,078	1,446,649,411	1.012	1,441,104,875	5,544,536
1,374,983,871	2017Q4	1,314,139,366	1,336,568,526	1.014	1,332,351,946	4,216,580
1,567,722,663	2018Q1	1,475,371,535	1,506,259,772	1.016	1,498,349,260	7,910,512
1,467,964,413	2018Q2	1,358,889,263	1,373,705,802	1.017	1,381,489,827	(7,784,025)
1,593,790,071	2018Q3	1,446,921,722	1,482,933,298	1.020	1,475,365,612	7,567,686
1,409,568,865	2018Q4	1,250,731,535	1,296,830,173	1.023	1,279,676,569	17,153,604
1,523,992,891	2019Q1	1,317,056,538	1,373,397,331	1.027	1,352,261,685	21,135,646
1,476,576,103	2019Q2	1,241,128,731	1,277,358,907	1.028	1,276,078,269	1,280,638
1,510,507,169	2019Q3	1,231,012,448	1,289,549,867	1.031	1,269,649,321	19,900,546
1,450,142,367	2019Q4	1,132,963,677	1,187,918,096	1.043	1,181,817,168	6,100,928
1,182,078,290	2020Q1	882,840,109	933,916,856	1.046	923,531,231	10,385,625
962,334,501	2020Q2	681,139,248	714,666,730	1.055	718,723,543	(4,056,813)
1,255,055,494	2020Q3	832,505,330	894,989,761	1.067	888,326,828	6,662,933
1,214,509,533	2020Q4	746,914,854	811,847,514	1.079	805,610,321	6,237,193
1,290,356,051	2021Q1	737,692,683	820,337,661	1.076	793,559,931	26,777,730
1,293,556,111	2021Q2	680,558,405	742,068,891	1.087	739,522,148	2,546,743
1,326,608,235	2021Q3	632,459,458	720,042,408	1.104	697,947,601	22,094,807
1,202,806,326	2021Q4	511,494,001	586,502,614	1.121	573,436,993	13,065,621
1,422,637,997	2022Q1	522,753,075	616,906,874	1.157	604,977,531	11,929,343
1,441,848,717	2022Q2	424,670,546	539,688,932	1.248	529,812,118	9,876,814
1,426,838,943	2022Q3	210,001,292	442,774,601	2.001	420,249,688	22,524,913

31,617,752,036

This exhibit shows how “ex-ante” or reserve runoff calculations are produced. This calculation, which rolls back each of the LDF sets to estimate what would have known at the time, to give one of the best actual vs expected early warnings of lengthening LDFs. In the highlighted cell, the 2.108 LDF experienced for 2022Q3, is higher then the prior 7 qtr LDFs average of 2.001, producing adverse development of 22.5M for that cell.



# General Liability – ExAnte Reserve Runoff

## All GL – Reserve Run-off Test @12/31/2022 - Ground-up

Illustrative

Overall Calendar Quarter				Adverse (Favorable) Development:															
				195,014,107	258,209,894	128,138,437	(29,650,890)	29,464,347	39,837,864	59,804,723	(169,753,396)	(41,765,598)	53,106,173	(91,703,438)	9,026,469	13,178,046	(19,520,715)	46,456,152	(34,698,730)
				551,711,546				(40,646,461)				(71,336,394)				5,414,753			
				CQ 2022Q4	CQ 2022Q3	CQ 2022Q2	CQ 2022Q1	CQ 2021Q4	CQ 2021Q3	CQ 2021Q2	CQ 2021Q1	CQ 2020Q4	CQ 2020Q3	CQ 2020Q2	CQ 2020Q1	CQ 2019Q4	CQ 2019Q3	CQ 2019Q2	CQ 2019Q1
% Adverse (Favorable) Development	Ultimate Est. @3 mos	Adverse (Fav) Devt																	
		AQ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
-8.6%	407,162,739	(34,831,878)	2017Q2	(16,057,455)	7,819,693	(3,197,351)	(6,467,568)	4,849,437	(6,898,065)	14,679,352	2,950,599	12,410,608	1,830,757	(11,447,109)	11,119,035	(4,035,944)	(67,483,089)	9,022,868	(2,529,607)
2.2%	556,201,399	12,250,910	2017Q3	5,544,536	11,589,868	(3,839,857)	3,863,030	4,652,882	(4,075,106)	9,408,762	(15,700,310)	(15,552,875)	8,135,221	(9,130,225)	1,161,317	(15,143,054)	16,260,660	11,310,759	11,599,310
9.5%	516,205,358	49,219,853	2017Q4	4,216,580	3,474,308	(6,634,070)	(11,794,914)	(6,774,868)	7,137,247	938,528	(4,323,093)	(8,857,348)	5,263,127	(7,665,291)	(13,005,300)	9,007,739	11,011,196	5,599,402	(5,153,705)
0.3%	712,962,427	2,227,552	2018Q1	7,910,512	1,258,546	6,255,450	11,626,001	(9,484,516)	9,990,942	1,962,787	(8,025,668)	(4,660,197)	(2,539,930)	70,950	(15,231,988)	1,586,784	14,899,150	(8,895,506)	(29,139,331)
-1.0%	755,119,428	(7,571,690)	2018Q2	(7,784,025)	3,316,751	4,134,367	9,435,952	2,611,929	2,588,459	(1,098,051)	(5,503,014)	(12,170,140)	(4,901,159)	(11,059,822)	8,271,184	(3,380,517)	3,037,971	2,831,816	(3,468,555)
8.3%	844,538,297	70,240,831	2018Q3	7,567,686	26,267,209	13,676,825	10,332,572	7,869,147	(13,336,484)	25,310,610	(24,664,883)	(10,336,248)	1,262,825	3,058,132	8,335,206	4,468,946	958,181	(2,569,524)	(3,918,355)
8.7%	812,003,270	70,985,825	2018Q4	17,153,604	17,497,566	17,308,129	7,076,037	14,637,065	(587,654)	(7,281,570)	(6,282,269)	(14,616,146)	2,140,907	(2,406,375)	2,394,096	1,754,818	6,402,141	17,883,964	(2,088,487)
-2.4%	1,046,580,274	(25,435,630)	2019Q1	21,135,646	10,686,525	4,294,787	4,479,550	4,130,502	(7,373,942)	5,495,158	(20,511,613)	(10,883,542)	(18,418,440)	(8,943,961)	(5,393,796)	14,130,174	(29,535,050)	11,272,372	
5.5%	955,966,973	52,176,731	2019Q2	1,280,638	16,244,270	12,315,639	(8,437,635)	13,359,791	487,804	(12,976,455)	(16,551,189)	(5,725,016)	98,213	2,900,119	12,066,989	12,185,437	24,928,125		
0.2%	1,222,414,093	2,262,207	2019Q3	19,900,546	22,408,704	8,182,638	1,300,969	(1,005,176)	8,861,996	(11,678,195)	(19,240,505)	4,065,479	(3,790,054)	(4,288,845)	(15,059,014)	(7,396,337)			
4.1%	1,102,091,188	45,462,327	2019Q4	6,100,928	18,200,545	7,140,953	(11,324,835)	12,785,681	(13,534,295)	(5,394,205)	(19,037,424)	5,970,360	21,940,628	8,245,252	14,368,739				
-0.8%	1,102,627,852	(8,489,695)	2020Q1	10,385,625	8,586,071	11,718,130	(5,617,411)	10,215,666	5,773,727	6,128,437	(12,853,818)	3,288,770	4,921,371	(51,036,264)					
4.7%	727,884,392	33,972,599	2020Q2	(4,056,813)	12,611,661	5,468,374	(11,312,747)	(6,436,663)	5,648,808	1,623,150	(7,690,012)	954,339	37,162,500						
4.6%	1,023,902,685	47,403,529	2020Q3	6,662,933	2,614,275	5,623,685	(5,850,401)	8,626,661	16,930,620	320,052	(1,870,653)	14,346,357							
4.6%	1,036,365,413	47,464,754	2020Q4	6,237,193	20,833,280	10,737,163	2,173,747	5,200,914	(5,337,403)	18,069,402	(10,449,543)								
2.9%	1,102,479,682	31,991,008	2021Q1	26,777,730	6,586,621	1,278,671	(12,618,602)	(8,087,299)	3,756,928	14,296,959									
1.2%	1,129,715,515	13,421,890	2021Q2	2,546,743	(1,472,398)	10,298,451	(19,786,429)	(7,968,759)	29,804,282		Minimum	Maximum	Actual vs Expected Development: AY x CY						
1.2%	1,244,801,940	15,106,376	2021Q3	22,094,807	9,859,125	(8,757,669)	11,628,160	(19,718,047)			-16.6%	-6.2%	1	Favorable development					
5.0%	1,031,658,582	51,970,905	2021Q4	13,065,621	15,746,383	21,515,268	1,643,633				-6.2%	-1.0%	50	Somewhat favorable					
2.2%	1,275,006,560	28,476,782	2022Q1	11,929,343	5,928,585	10,618,855					-1.0%	1.0%	125	Within +/-1.0% of original estimate					
3.9%	1,237,589,964	48,029,122	2022Q2	9,876,814	38,152,308						1.0%	2.4%	59	Somewhat adverse					
1.6%	1,426,838,943	22,524,913	2022Q3	22,524,913							2.4%	5.1%	17	Adverse development					
Total Loss		21,270,116,972	568,859,221	2.7%															

Comparing to initial selected excess loss ultimates at 3 months using a mechanical 7-year average, produces adverse development across all quarters since 2020Q2.

# General Liability – ExAnte Reserve Runoff

## All GL – Reserve Run-off Test @12/31/2022 – BI xs 25k

Illustrative

Overall Calendar Quarter Adverse (Favorable) Development:				193,812,968	205,190,215	69,321,087	(783,009)	36,224,542	8,713,367	6,164,682	(151,936,855)	(37,623,767)	20,678,901	(22,967,155)	(8,572,943)	(18,387,742)	(11,182,604)	(1,406,380)	(23,456,767)
				467,541,260				(100,834,264)				(48,484,964)				(54,433,492)			
				CQ 2022Q4	CQ 2022Q3	CQ 2022Q2	CQ 2022Q1	CQ 2021Q4	CQ 2021Q3	CQ 2021Q2	CQ 2021Q1	CQ 2020Q4	CQ 2020Q3	CQ 2020Q2	CQ 2020Q1	CQ 2019Q4	CQ 2019Q3	CQ 2019Q2	CQ 2019Q1
% Adverse (Favorable) Development	Ultimate Est. @3 mos	Adverse (Fav) Devt	AQ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
19.8%	123,710,486	24,475,598	2017Q2	(1,286,551)	6,413,963	1,390,633	(2,753,882)	3,876,486	(5,186,234)	14,999,472	670,506	12,232,387	(3,135,672)	(6,452,897)	19,540,257	(8,759,181)	(52,789,832)	4,554,733	(4,268,137)
1.7%	236,974,354	4,125,069	2017Q3	4,268,688	11,213,537	(3,117,366)	7,476,358	6,169,183	(1,823,514)	4,569,836	(11,806,782)	(14,147,318)	3,765,895	(3,615,078)	669,349	(12,235,539)	13,001,177	(2,900,820)	1,607,301
9.9%	233,007,010	23,132,884	2017Q4	4,811,473	1,350,271	(8,758,421)	(8,364,572)	(6,126,395)	13,665,066	(166,984)	(6,545,359)	(11,565,676)	6,680,854	(5,770,771)	(14,031,582)	8,454,946	5,640,916	538,092	(3,533,040)
-6.1%	395,871,298	(24,280,670)	2018Q1	7,191,016	1,888,799	5,786,032	10,016,147	(6,687,472)	8,911,798	4,599,946	(12,896,006)	(12,045,792)	(4,121,154)	(192,806)	(18,290,852)	2,734,765	10,705,705	(7,889,081)	(19,249,556)
6.2%	367,842,834	22,979,785	2018Q2	(6,353,469)	5,181,649	3,719,009	12,416,119	1,662,621	(196,637)	(1,056,926)	(6,331,588)	(3,384,702)	(68,701)	(992,891)	7,716,413	181,141	6,146,121	(447,673)	2,420,236
14.8%	451,640,884	66,897,748	2018Q3	1,727,534	19,773,716	10,245,498	13,996,209	8,394,417	(13,058,451)	20,249,889	(16,792,472)	(10,842,308)	1,872,457	14,867,173	2,297,336	8,987,551	506,403	(3,659,688)	(3,463,429)
9.7%	474,657,161	45,805,361	2018Q4	13,666,548	15,728,377	13,896,503	6,122,937	8,453,321	1,429,845	(7,104,187)	(5,021,174)	(14,911,069)	551,285	(105,722)	(1,926,632)	(6,757,514)	4,678,781	14,074,205	3,029,858
-6.5%	719,078,341	(46,434,192)	2019Q1	20,814,112	11,257,680	(1,970,680)	5,443,112	7,808,744	(13,094,027)	8,318,720	(21,018,131)	(11,023,967)	(19,746,175)	(2,226,302)	(9,423,394)	(2,862,607)	(13,035,130)	(5,676,147)	
4.6%	565,557,702	26,174,775	2019Q2	(2,916,079)	13,015,752	10,740,917	(10,092,393)	9,556,132	1,075,526	(14,670,880)	(12,635,392)	(258,480)	(884,972)	6,088,644	9,224,472	3,968,274	13,963,254		
2.1%	828,801,240	17,618,026	2019Q3	21,385,230	23,710,176	6,918,691	4,608,116	(1,877,515)	12,107,303	(12,905,140)	(11,666,283)	3,113,977	(1,791,862)	(4,819,313)	(9,065,778)	(12,039,577)			
3.6%	735,879,992	26,749,446	2019Q4	10,963,682	16,113,601	6,349,765	(7,460,194)	10,990,902	(16,759,887)	(9,501,856)	(20,113,847)	8,140,571	20,339,886	2,969,355	4,717,468				
-0.5%	802,132,117	(4,385,835)	2020Q1	6,463,956	9,463,715	4,593,498	(4,764,429)	14,714,835	774,420	(1,543,544)	(9,772,423)	1,528,908	(3,128,224)	(22,716,548)					
10.1%	379,784,086	38,305,276	2020Q2	(7,547,345)	17,239,825	7,405,700	(8,213,189)	(2,645,705)	7,918,664	3,650,195	1,458,669	(1,306,569)	20,345,032						
5.2%	645,381,064	33,801,905	2020Q3	6,887,016	3,200,279	2,905,233	(4,447,570)	7,283,142	11,050,594	(4,866,772)	(5,056,288)	16,846,271							
0.7%	796,868,019	5,203,949	2020Q4	6,739,933	17,568,680	4,722,528	(7,432,446)	(3,693,810)	(9,570,658)	11,280,006	(14,410,285)								
-0.3%	915,539,371	(2,548,939)	2021Q1	26,454,748	5,019,368	(1,670,923)	(12,914,552)	(7,809,397)	(1,941,089)	(9,687,094)									
1.4%	742,183,232	10,286,024	2021Q2	6,193,165	1,376,281	3,137,415	(13,606,890)	(224,594)	13,410,647										
2.0%	836,790,164	16,447,806	2021Q3	18,077,328	5,690,959	(9,262,118)	15,561,992	(13,620,355)											
4.0%	720,110,439	28,812,190	2021Q4	12,948,963	(1,012,228)	13,249,338	3,626,117												
1.6%	1,004,219,818	16,432,156	2022Q1	15,525,127	1,867,192	(960,163)													
2.8%	830,026,497	22,842,529	2022Q2	3,713,904	19,128,624														
2.5%	965,192,687	24,083,987	2022Q3	24,083,987															
Total Loss				13,771,248,794	376,524,879	2.7%													

PremOps | Products | Other  
GL-Comp Op | GL-Contr | GL-CRR | GL-Lcl Prd | GL-Liquor | GL-Mfg | GL-OLT | GL-Prod  
Faster | Slower Midwest | North | South | West  
BI >=25k

Note: Using last 7 factors for Incurred LDF

Similar to total GL GU, BI claims excess of 25k have for developed adversely for almost all quarters since 2020Q2.

Minimum	Maximum	Actual vs Expected Development: AY x CY
-42.7%	-14.9%	1 Favorable development
-14.9%	-1.0%	70 Somewhat favorable
-1.0%	1.0%	88 Within +/-1.0% of original estimate
1.0%	5.9%	86 Somewhat adverse
5.9%	15.8%	7 Adverse development

## C. Main Impacts

- **Severities up** beyond normal increases
- **Frequencies down** significantly below pre-pandemic, also below normal base-line decreases
- **Adverse development**
- **Delayed closures** and catch-up settlements
  - 1<sup>st</sup> evaluation claims: maybe “Robbing Peter to Close Paul”
- **Increasing loss ratios**
- **Concern for future:**
  - if average severities remain high, frequencies revert closer to pre-pandemic, closure catch-up continues to occur, and adverse development continues
  - loss ratios could significantly increase soon as the pandemic abates



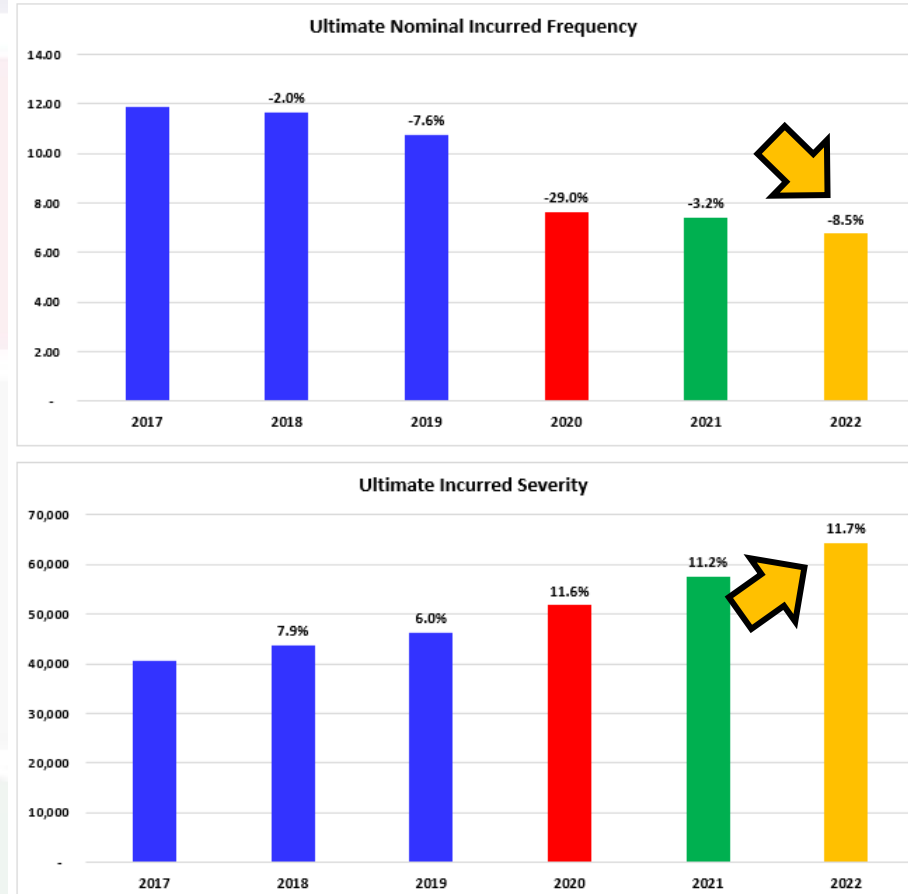
# Recent Trends Impacted by Covid / Inflation – Total GL 2017 through 2022 Year-End - Nominal

Illustrative

GL showed a 29% frequency reduction in 2020 due to Covid, with similar depressed level in 2021 and further reduction in 2022. Average severities increased in 2020, 2021, and 2022 by about 11% each year, compared to the 6-7% trends that we had been seeing in the past.

## Questions:

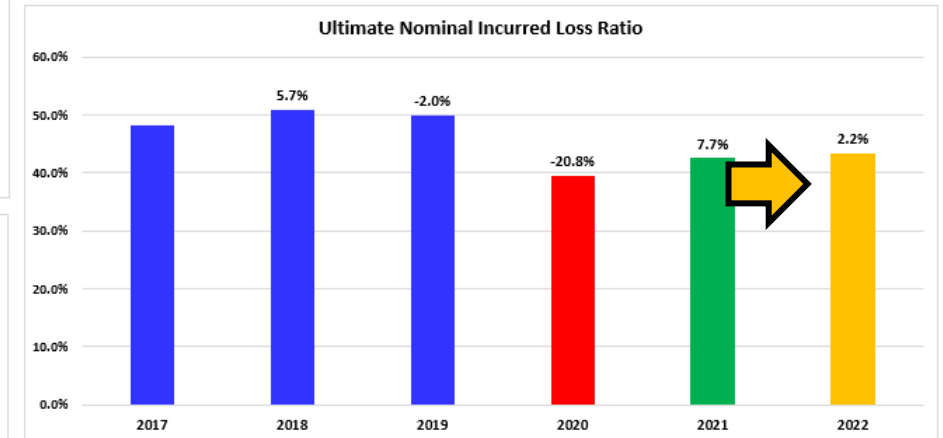
- how long will it take for the frequencies to return to normal or new normal levels?
- how much of this heightened inflation is expected to continue into 2023 and beyond?



**ISO SOLM QCR**

Subline	PremOps   Products   Other
Class Group	GL-Comp Op   GL-Contr   GL-CRR   GL-Ld Prd   GL-Liquor   GL-Mfg   GL-OLT   GL-Pollution   GL-Prod
Region	Midwest   North   South   West
Cause of Loss	All Causes of Loss
Claim Size	>=25k   1 - <10k   10k - <25k
Company Speed	Faster   Slower

SOLM Qtr GL 2022 Q4  
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CvIF			
	Frequency	Severity	Loss Ratio
2020	0.668	1.188	0.796
2021	0.647	1.322	0.857
2022	0.591	1.477	0.875

# of Claims (6 years) 677,196

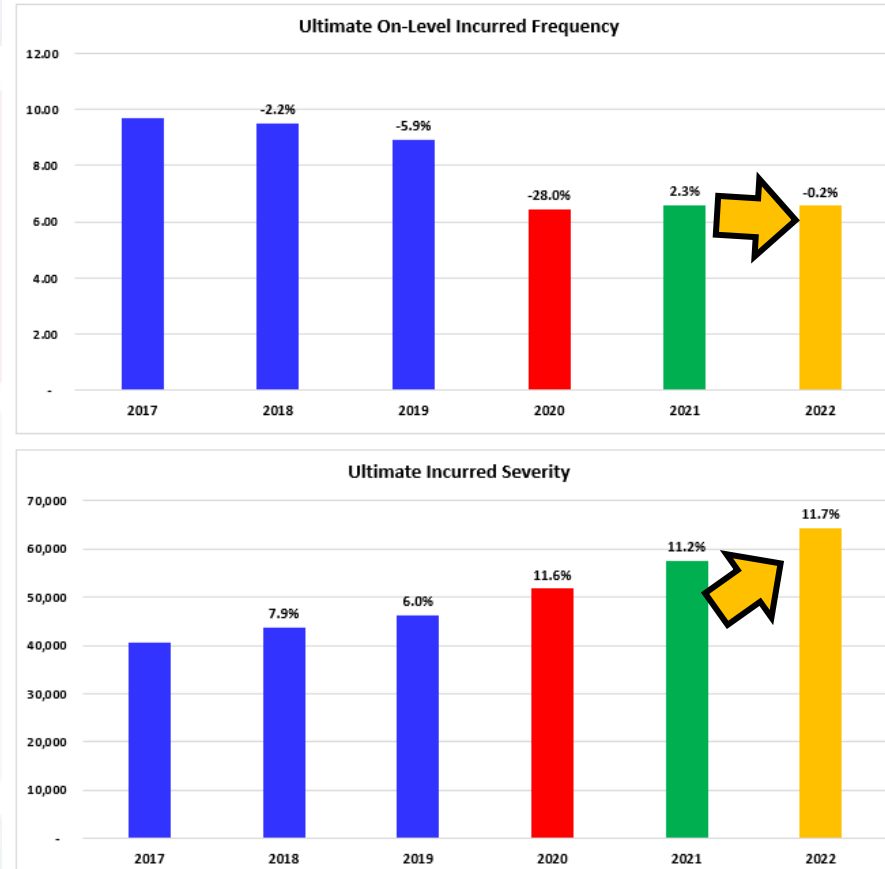
**NB: mechanical selection for LDFs of last 7 qtr VWA used in projections from GL SOLM-Qtr at 12/31/2022. No tail beyond 2017 supplied. Indemnity Only uses ISO MarketWatch 6/30/2022 rate changes**



# Recent Trends Impacted by Covid / Inflation – Total GL 2017 through 2022 Year-End – On-level

Illustrative

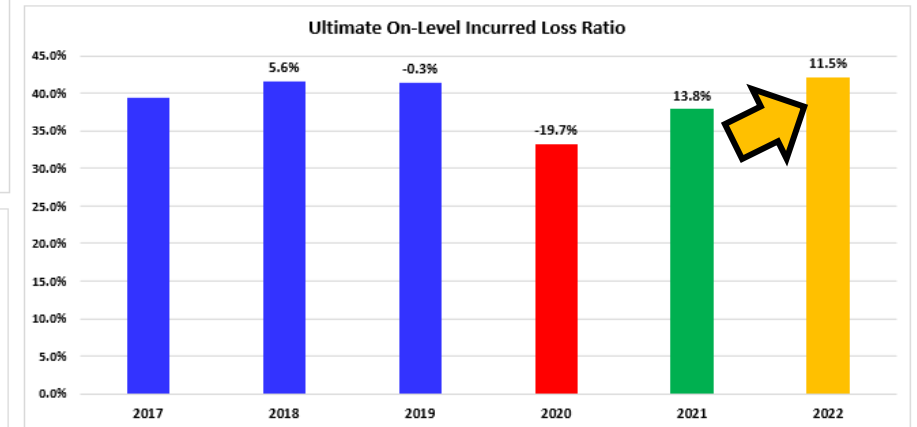
On an On-Level basis, GL showed a 28% frequency reduction in 2020 due to Covid, with a slight increase in frequency in 2021 and similar level in 2022. This slight frequency increase coupled with the 11% severity increases in recent years has led to increasing on-level loss ratios to about pre-pandemic levels in 2022. If severities continue to stay high and frequencies return closer to pre-pandemic levels, loss ratios may continue to rise.



**ISO SOLM QTR**

SOLM Qtr GL 2022 Q4  
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Subline: PremOps | Products | Other  
Class Group: GL-Comp Op | GL-Contr | GL-CRR | GL-Ld Prd | GL-Liquor | GL-Mfg | GL-OLT | GL-Pollution | GL-Prod  
Region: Midwest | North | South | West  
Cause of Loss: All Causes of Loss  
Claim Size: >=25k | 1 - <10k | 10k - <25k  
Company Speed: Faster | Slower



CvIF

	Frequency	Severity	Loss Ratio
2020	0.685	1.188	0.816
2021	0.701	1.322	0.928
2022	0.699	1.477	1.035

# of Claims (6 years) 677,196

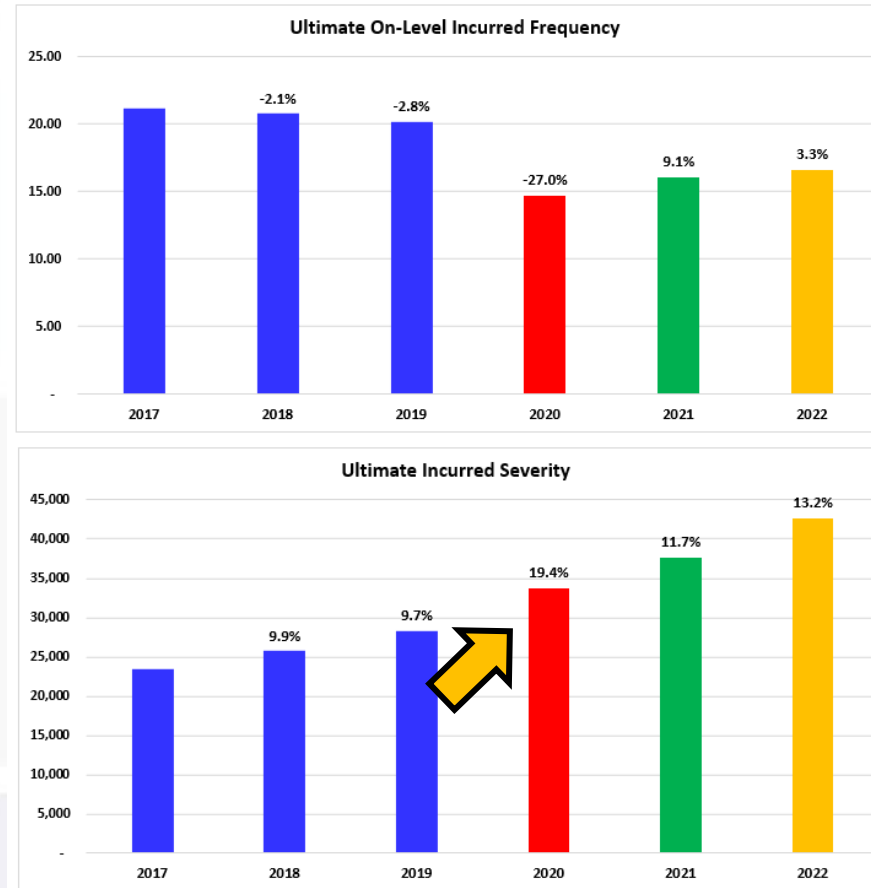
**NB: mechanical selection for LDFs of last 7 qtr VWA used in projections from GL SOLM-Qtr at 12/31/2022. No tail beyond 2017 supplied. Indemnity Only uses ISO MarketWatch 6/30/2022 rate changes**



# Recent Trends Impacted by Covid / Inflation – Total CAu 2017 through 2022 Year-End – On-Level

Illustrative

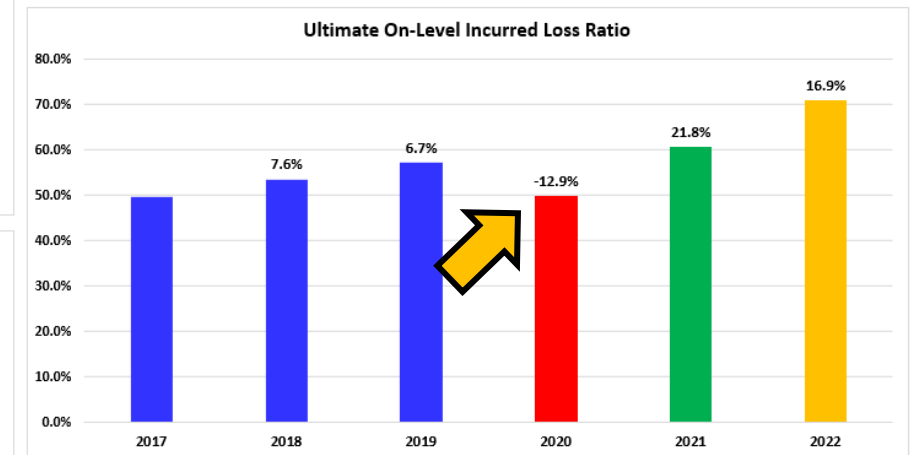
As observed previously, in 2020 there was a significant frequency reduction driving a significant loss ratio reduction. For severity, we see YTY changes significantly higher than in the past with increases above 10% in 2020 - 2022. This large increase in severity, paired with a partial rebound in frequency led to an increase in loss ratio in 2021 and 2022 to higher than pre-pandemic levels.



ISO SOLM QCR

Class Group Liability  
Region Midwest | North | South | West  
Cause of Loss All Causes of Loss  
Claim Size 1 - <10k | 10k - <25k | >=25k

SOLM Qtr CAu 2022 Q4  
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CvIF	Frequency	Severity	Loss Ratio
2020	0.711	1.307	0.931
2021	0.776	1.459	1.134
2022	0.801	1.651	1.325

# of Claims (6 years) 1,574,141

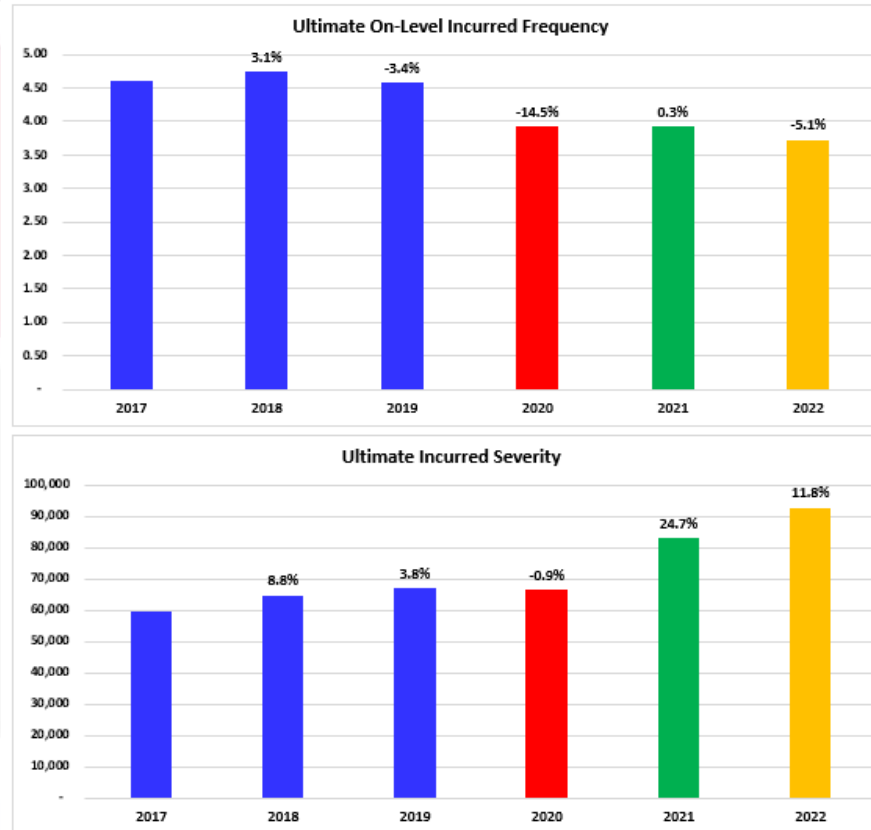
NB: mechanical selection for LDFs of last 7 qtr VWA used in projections from CAu SOLM-Qtr at 12/31/2022. No tail beyond 2017 supplied. Indemnity Only  
uses ISO MarketWatch 6/30/2022 rate changes



# Recent Trends Impacted by Covid / Inflation – Total CP 2017 through 2022 Year-End – On-Level

Illustrative

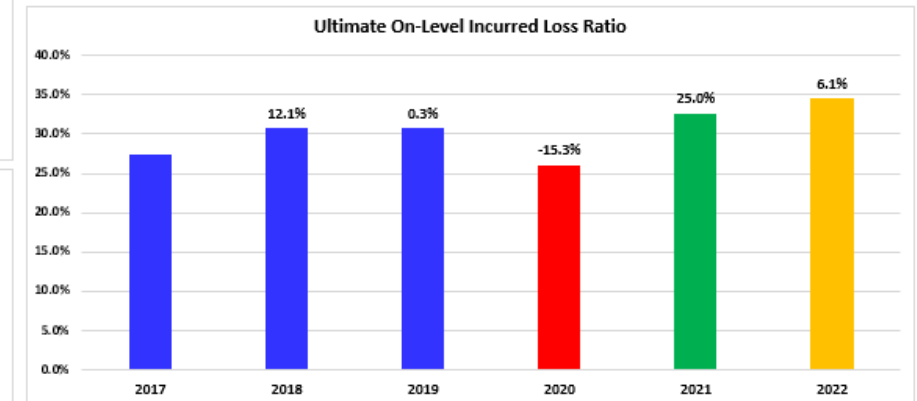
CP showed a 14.5% on-level frequency reduction in 2020 due to Covid, with similar depressed level in 2021 and further reduction in 2022. Average severities increased in 2021 and 2022 by about 25% and 12% respectively, much higher than in prior years. This led to on-level loss ratios getting to higher than pre-pandemic levels in 2022.



ISO SOLM QTR

SOLM Qtr CP 2022 Q4  
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Market CP-Comm | CP-Mfg | CP-Resid  
Class Group All Classes  
Region Midwest | North | South | West  
Cause of Loss All No CAT  
Claim Size >=100k | 1 - <25k | 25k - <100k



CvIF			
	Frequency	Severity	Loss Ratio
2020	0.844	1.044	0.880
2021	0.846	1.301	1.101
2022	0.803	1.455	1.168

# of Claims (6 years) 273,209

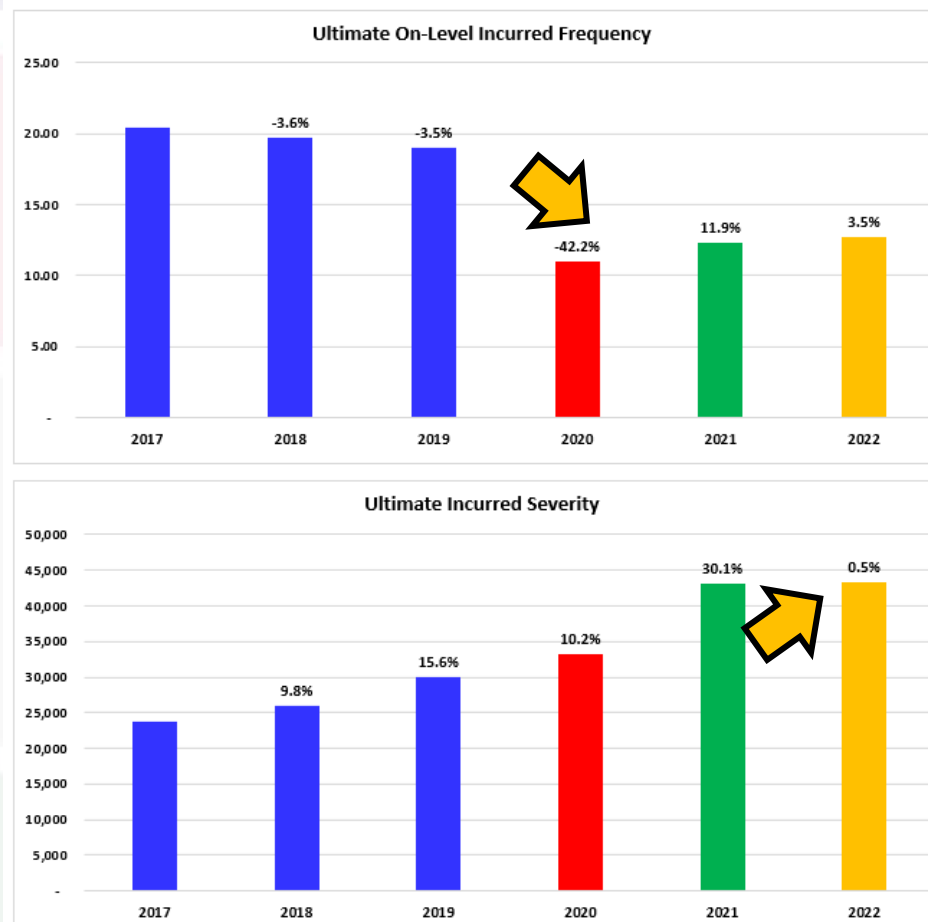
NB: mechanical selection for LDFs of last 7 qtr VWA used in projections from CP SOLM-Qtr at 12/31/2022. No tail beyond 2017 supplied. Indemnity Only uses ISO MarketWatch 6/30/2022 rate changes



# Recent Trends Impacted by Covid / Inflation – GL Restaurants & Bars 2017 through 2022 Year-End – On-level

Illustrative

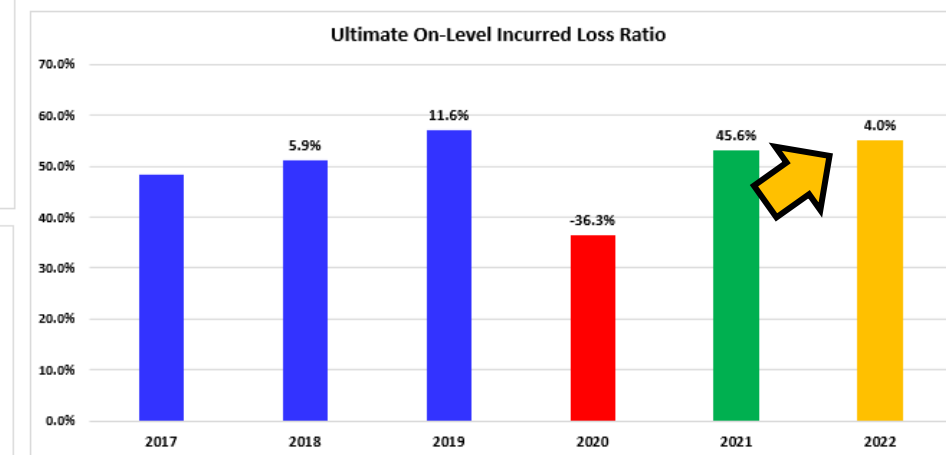
GL Restaurants and Bars was one of the most impacted class groups for GL over the past 3 years. On-Level frequency fell more than 40% in 2020 due to the pandemic, but then saw a 12% recovery in 2021 with slight increase again in 2022. Severity saw a significant increase in 2021 of 30% with similar level in 2022. These frequency and severity impacts led to a sharp drop in on-level loss ratio in 2020 with increases back to pre-pandemic levels in 2021 and 2022.



**ISO SOLM QCR**

Subline: PremOps | Products: Restaurants and Bars  
Region: Midwest | North | South | West  
Cause of Loss: All Causes of Loss  
Claim Size: >=25k | 1 - <10k | 10k - <25k  
Company Speed: Faster | Slower

SOLM Qtr GL 2022 Q4  
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CvIF			
	Frequency	Severity	Loss Ratio
2020	0.557	1.247	0.697
2021	0.623	1.622	1.014
2022	0.645	1.631	1.055

# of Claims (6 years) 44,558

**NB: mechanical selection for LDFs of last 7 qtr VWA used in projections from GL SOLM-Qtr at 12/31/2022. No tail beyond 2017 supplied. Indemnity Only uses ISO MarketWatch 6/30/2022 rate changes**



# Residual Trends (ART) – GL Restaurants & Bars (incl Covid Adjustment)

Illustrative

GL Restaurants and Bars

	SGU Nominal Losses		Nominal Premium Ultimate	Nominal Loss Ratio		On Level Loss Ratio Ultimate	70%10%20%				30%70%				0%100%				Covid CVRR			Adj Loss Ratio	
	To DateUltimate			To DateUltimate			Frequency Trend				Severity Trend				Exposure Trend		Rate Change						
	Individual Year	7 Yr	2 Yr	Selected	Individual Year	7 Yr	Selected	Gross Sales	M1	M3	Selected	Premium	Claim Count	Avg Incurred	Before Covid	After Covid							
Covid Covid/Inf Covid/Inf	2012	222,377,992	222,208,234	293,747,098	75.7%	75.6%	75.6%	-16.3%	0.0%	14.9%	-8.4%	11.3%	16.5%	14.9%	0.0%	6.1%	8.0%	8.0%	1,000	1,000	1,000	77.6%	77.6%
	2013	245,700,398	245,703,259	342,196,144	71.8%	71.8%	71.8%	-4.5%	0.0%	4.9%	-2.1%	-0.6%	16.5%	11.4%	0.0%	6.7%	8.1%	8.1%	1,000	1,000	1,000	71.2%	71.2%
	2014	252,927,008	253,235,035	358,318,866	70.6%	70.7%	70.7%	-18.5%	0.0%	-9.0%	-14.7%	20.7%	16.5%	17.8%	0.0%	4.7%	4.5%	4.5%	1,000	1,000	1,000	73.5%	73.5%
	2015	256,320,178	256,911,937	369,912,078	69.3%	69.5%	69.5%	-13.9%	0.0%	-11.2%	-12.0%	14.2%	16.5%	15.8%	0.0%	1.8%	3.0%	3.0%	1,000	1,000	1,000	70.2%	70.2%
	2016	266,560,702	270,116,682	387,333,269	68.8%	69.7%	69.7%	-2.3%	0.0%	-12.5%	-4.1%	2.7%	16.5%	12.4%	0.0%	1.6%	1.8%	1.8%	1,000	1,000	1,000	65.9%	65.9%
	2017	269,458,365	269,247,257	460,817,692	58.5%	58.4%	71.5%	-0.5%	0.0%	-17.7%	-3.9%	3.1%	16.5%	12.5%	0.0%	1.0%	-0.5%	-0.5%	1,000	1,000	1,000	53.8%	53.8%
	2018	277,422,594	283,050,920	461,439,344	60.1%	61.3%	74.2%	-4.4%	0.0%	-8.7%	-4.8%	9.8%	16.5%	14.5%	0.0%	2.3%	0.9%	0.9%	1,000	1,000	1,000	56.8%	56.8%
	2019	293,944,522	323,327,947	470,614,069	62.5%	68.7%	78.5%	-3.1%	0.0%	-1.4%	-2.5%	15.6%	16.5%	16.2%	0.0%	3.6%	-2.2%	-2.2%	1,000	1,000	1,000	59.3%	59.3%
	2020	156,400,720	198,818,377	424,057,507	36.9%	46.9%	54.7%	-38.1%	0.0%	-1.9%	-27.0%	10.2%	16.5%	14.6%	0.0%	6.8%	-5.3%	-5.3%	0.913	0.557	1.247	53.1%	61.7%
	2021	190,672,178	309,887,641	474,516,735	40.2%	65.3%	72.2%	7.0%	-8.6%	-1.7%	3.7%	30.1%	16.5%	20.6%	0.0%	7.2%	15.6%	15.6%	1.022	0.623	1.622	60.4%	66.0%
2022	125,730,107	327,489,345	560,175,801	22.4%	58.5%	67.5%	-11.0%	7.9%	15.5%	-3.8%	0.5%	16.5%	11.7%	0.0%	5.3%	20.2%	20.2%	1.207	0.645	1.631	65.4%	67.1%	
Total	2,431,784,657	2,632,507,289	4,042,952,800	60.1%	65.1%	70.8%																64.2%	65.6%
Residual Trend																	-3.77%			-2.65%			

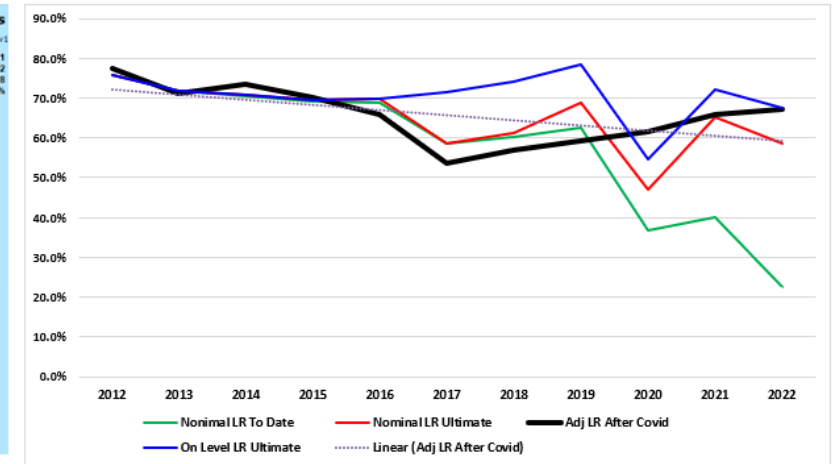
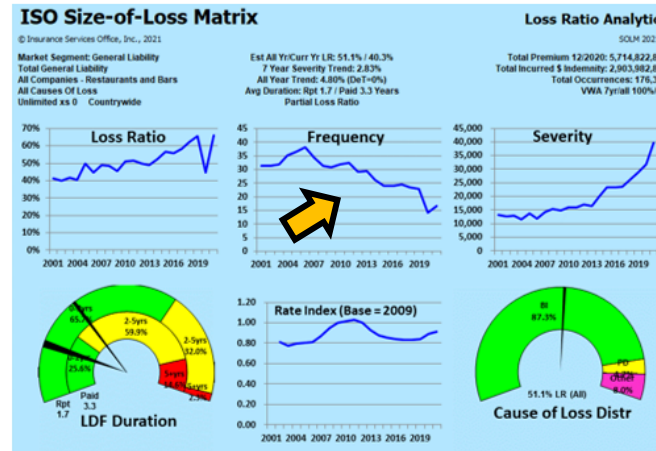
Residual Trend -3.77% -2.65%

Nominal ultimate loss ratios were adjusted by various development, trend, and on-leveling adjustments. The goal of this analysis is to end up with a straight line of loss ratios (black line on graph) that only exhibit random variations around a mean (process variance).

Any remaining trend would be due to not including enough adjustments (coverage changes, risk management improvements, one-time plateau events in either direction (Great Recession), etc. These are similar adjustments that are relevant to Rate Change Method 5.

This is especially important in 2020/2021 and beyond as if it is believed that the Covid Pause, with its impact on economic and loss activity, will eventually revert back to normal, then there would need to be an explicit adjustment for both the numerator and denominator.

This same analysis can be done on other metrics such as frequencies, excess layers, partial loss trends, etc.



In this example, there is a generally negative positive trend in the adjusted loss ratios of about 2.65%, with some moderate downward trend from 2015-2017 and then some moderate upward trend since 2017. Therefore, we can conclude that there must be some loss or premium influences that have not been considered.



# Benchmark Assessment Matrix

## Estimating Confidences – Post Pandemic - Illustrative

Your post pandemic assessment of parameter confidence should reflect any unknowns that may occur as to frequency drop reversals, closures back to normal, inflations impacts, adverse development, size of claim impacts, etc. The confidence levels of some attributes may still remain high, like well monitored rate changes. But others in particular longer tail line frequencies, excess severities, ILFs, and LR's may suffer due to the additional unknowns.

Some of the benchmarks may in essence become "couchmarks".

	1	2	3	4	5	6	7	8
	Trends							State/ Hazard/ Subline
	Ground Up			Excess		Loss Dev't Factors		
	Severity	Frequency	Exposure	Severity	Frequency	Ground Up	Excess	
Casualty	●	⊙	●	⊙	⊙	●	●	●
Property	●	●	●	●	⊙	●	●	●
Specialty	●	⊙	○	●	⊙	●	●	⊙
	9	10	11	12	13	14	15	16
	Rate Changes		Loss Costs		External Forces	Loss Ratios		Where In the Cycle?
	Primary	Reinsurance	Ground-up	ILFs		Primary	Reinsurance	
Casualty	●	●	●	⊙	○	⊙	⊙	⊙
Property	●	●	●	●	○	●	●	●
Specialty	●	●	⊙	⊙	○	⊙	⊙	⊙
Confidence:	Good	●	Medium	●	Some	⊙	Minimal	○



# Mechanical Indication of Trends @12/2022– Post Pandemic

Illustrative

Metrics for Pre Covid, First 2 Covid years and Heightened Inflation year	90% CI (Responses)		"Actual"
	Lower	Upper	
1. Total GL Annual Severity Change – 2015-2019			4.2%
2. Total GL Annual Severity Change – 2019-2021			11.4%
3. Total GL Severity Change – 2021-2022			11.7%
4. Total GL Annual Frequency Change – 2015-2019			-4.1%
5. Total GL Annual Frequency Change – 2019-2021			-12.9%
6. Total GL Frequency Change – 2021-2022			-0.2%
7. Total CAu Annual Severity Change – 2019-2022			12.3%
8. Total CAu Annual Frequency Change – 2019-2022			-5.8%
9. Total CP Annual Severity Change – 2019-2022			11.9%
10. Total CP Annual Frequency Change – 2019-2022			-6.5%

- Actual annual trend indications using SOLM-Qtr mechanical LDFs last 7 quarters  
Frequency indications use on-level premium @12/31/2022 as base





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# Questions and Feedback