CS10: Intermediate Experience and Exposure Methods for Today

CS10: Intermediate Experience and Exposure Rating Methods for Today

CARe Seminar, June 13-14, 2022 – Virtual Event

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Intermediate Track Pre-Requisites

Prerequisites

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

CS10: Intermediate Experience and Exposure Rating Methods for Today

This session will build upon prior basic CARe track and boot camp materials and will presuppose familiarity with the basics of exposure and experience rating methodologies. This session will include the usage of more advanced techniques to address common excess rating challenges, exacerbated by the various extra stresses and data distortions currently being encountered. These additional distortions include:

- Shifting policy limits, credibility and blending of loss development factors, method confidence levels
- Recent heightened inflation, social inflation, civil unrest, and Covid impacts including on LDFs

Accurately assessing these impacts holistically, will lead to more refined:

- Benchmarking and individual account analysis
- Avoiding overconfidence in experience and exposure rating

Moderator:
Caitlyn Pace, ACAS, Senior Treaty Underwriter, Swiss Re (Moderator) *(post poll trend Qs)*

Panelists:
David Fairchild, FCAS, Vice President & Managing Actuary, Partner Re *(repost poll trend Qs)*

Shani Clarke, Actuarial Consultant, Verisk/ISO Underwriting Solutions UK *(poll trend As)*

Q&A 10 mins

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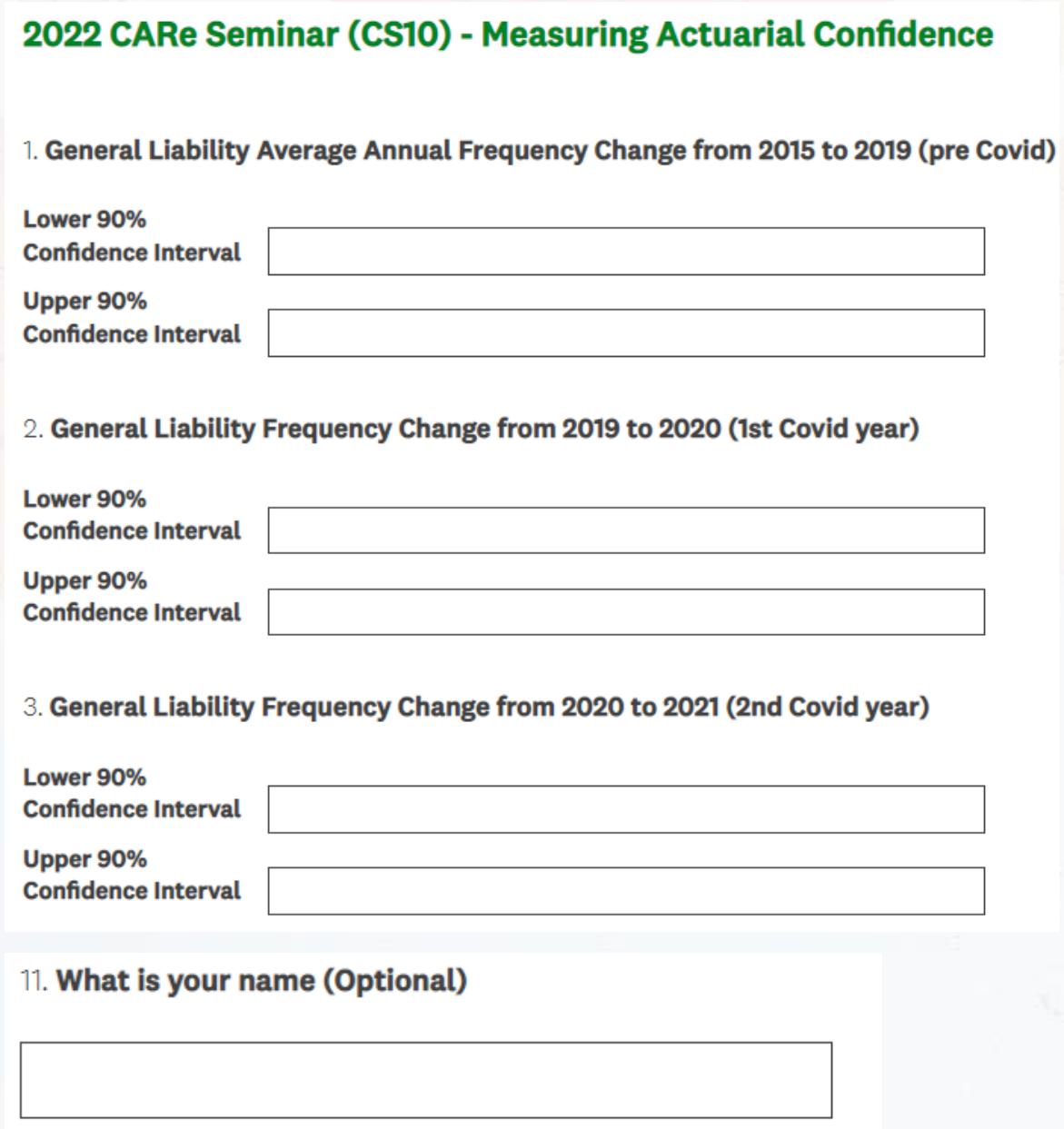
Measuring Confidence – Covid/Inflation Trends – Qs TBD



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 are **asking 10 Qs** via Survey Monkey that will be left up during the course of David and Shani's CS10 presentations. **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.

"Answers" will be presented at the end of Shani's section. You can answer either **anonymously, or provide your name** at the end.

Measuring Confidence answers, comparing aggregated confidence interval ranges to the "Answers", will be provided in the **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.

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CARe – Intermediate Experience & Exposure Rating Methods for Today

David Fairchild

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Supporting Source Materials

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- Much of the source content is derived from previous CARe presentations and published papers
- Original source information and special thanks to:
  - Mata & Verheyen “An Improved Method for Experience Rating Reinsurance Treaties using Exposure Rating Techniques” (2005)
    http://www.casact.org/pubs/forum/05spforum/05spf171.pdf
  - David R. Clark – “Introduction to Bayesian Loss Development” (2016)
    http://www.casact.org/pubs/forum/16sforum/Clark.pdf
  - Shi/Hartman – “Credibility in Loss Reserving” (2014)
    https://www.casact.org/pubs/forum/14sumforumv2/Shi_Hartman.pdf
  - Conger & Lowe “Managing Overconfidence” (2003)

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Agenda – CS10 Intermediate Exposure / Experience

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- **Shifting Limits in Excess of Loss Ratings – A Brief Example**
- **Credibility In Loss Development**
  1. Sample Company
  2. Loss Development Credibility
  3. Experience Rating
  4. Credibility Blending of Experience and Exposure
- **Actuarial Overconfidence**
  1. Measuring Overconfidence – Polling Qs
  2. Exposure Rating
  3. Experience Rating

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Shifting Limits in Excess of Loss Ratings

A Brief Example

Shifting Limits in Excess of Loss Rating

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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

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- **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

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

	Policy Limit Distribution			Exposure Rate	
AY	500,000	750,000	1,000,000	*250,000 excess of 250,000*	*500,000 excess of 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.

Mata & Verheyen “An Improved Method for Experience Rating Reinsurance Treaties using Exposure Rating Techniques” (2005)
http://www.casact.org/pubs/forum/05spforum/05spf171.pdf

Shifting Limits in Excess of Loss Rating

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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%		
	750,000	20.0%	7.83%		
	1,000,000	5.0%	13.01%	2.22%	1.88
2021	500,000	60.0%	0.00%		
	750,000	20.0%	7.83%		
	1,000,000	20.0%	13.01%	4.17%	1.00

- 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**

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Credibility in Loss Development

Credibility In Loss Development

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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

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	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

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

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- We need to create a “prior distribution” of development patterns.
- In a perfect world, these patterns should and would vary for all relevant risk characteristics:
  - Lines of business distinctions
  - Class of business and hazard groupings
  - Differences in coverage triggers (risks attaching vs. claims made vs. occurrence)
  - Policy limit and attachment point distributions

Shi/Hartman “Credibility in Loss Reserving” (2014) https://www.casact.org/pubs/forum/14sumforumv2/Shi_Hartman.pdf

Clark “Introduction to Bayesian Loss Development” (2016) http://www.casact.org/pubs/forum/16sforum/Clark.pdf

Credibility In Loss Development

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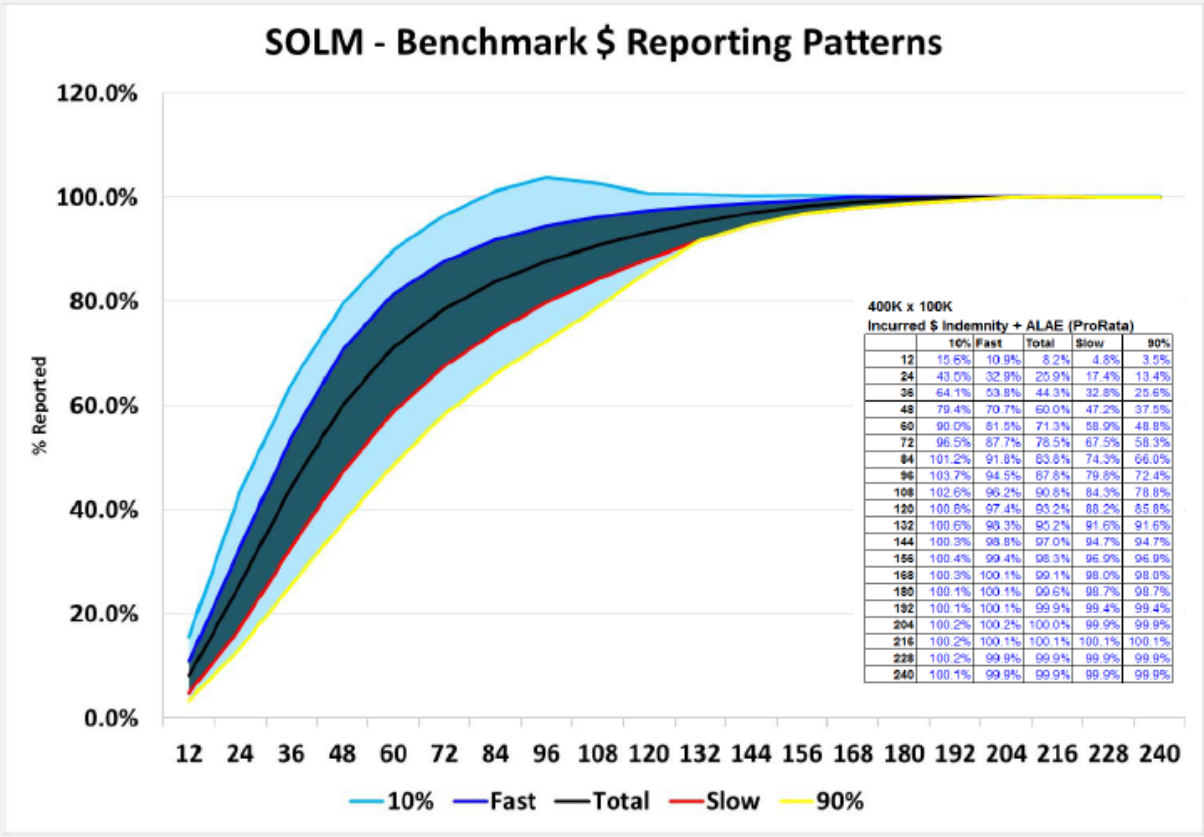

	10%	Fast	Total	Slow	90%
12	15.6%	10.9%	8.2%	4.8%	3.5%
24	43.5%	32.8%	25.9%	17.4%	13.4%
36	64.1%	53.8%	44.3%	32.8%	25.6%
48	79.4%	70.7%	60.0%	47.2%	37.5%
60	90.0%	81.5%	71.3%	58.9%	48.8%
72	96.5%	87.7%	78.5%	67.5%	58.3%
84	101.2%	91.8%	83.6%	74.3%	66.0%
96	103.7%	94.5%	87.8%	79.8%	72.4%
108	102.6%	96.2%	90.8%	84.3%	78.8%
120	100.8%	97.4%	93.2%	88.2%	85.8%
132	100.6%	98.3%	95.2%	91.6%	91.6%
144	100.3%	98.8%	97.0%	94.7%	94.7%
156	100.4%	99.4%	98.3%	96.9%	96.9%
168	100.3%	100.1%	99.1%	98.0%	98.0%
180	100.1%	100.1%	99.6%	98.7%	98.7%
192	100.1%	100.1%	99.9%	99.4%	99.4%
204	100.2%	100.2%	100.0%	99.9%	99.9%
216	100.2%	100.1%	100.1%	100.1%	100.1%
228	100.2%	99.9%	99.9%	99.9%	99.9%
240	100.1%	99.8%	99.9%	99.9%	99.9%

- In addition to the client data from two slides before, we also have industry data or client benchmark data. Here we have a range of patterns with varying development speeds.
- The above is industry SOLM data with the 10% bar representing the average of the quickest 10% of companies in the database. As a reinsurer we can also build out a range of excess of loss development patterns by line of business to generate a similar structural concept.

Credibility In Loss Development

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400K xs 100K graph

- The blue lines (taken from the prior slide) 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 xs 500K graph

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

Credibility In Loss Development

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Bayesian Theory

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

- Where
  - $f(\theta)$ is a distribution representing "prior" knowledge of the parameters θ
  - $f(x \mid \theta)$ is a likelihood function representing the probability of observing the actual data x given a certain set of parameter assumptions.
  - $f(\theta \mid x)$ is the "posterior" probability of the parameters, revised based on the data
- For the loss development pattern problem, we need a multivariate conjugate relationship.

Dirichlet => Multinomial

Credibility In Loss Development

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Bayesian Theory

- 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.

Credibility In Loss Development

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Application

- Select “Fast”, “Medium”, and “Slow” benchmark patterns as a starting point for three representative levels. If we do not know anything regarding the risk characteristics of the client, we can begin with the apriori assumption of equal weights.

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

	12	24	36	48	60	72	84	96	108	120	Apriori Weights
Fast	7.547	2.618	1.696	1.332	1.166	1.086	1.043	1.028	1.019	1.013	33.33%
Medium	12.195	3.861	2.257	1.667	1.403	1.274	1.193	1.139	1.101	1.073	33.33%
Slow	24.096	6.494	3.425	2.361	1.857	1.590	1.426	1.314	1.226	1.149	33.33%
Average	11.720	3.774	2.265	1.691	1.423	1.285	1.201	1.149	1.109	1.076	

- We credibility weight each of the three benchmark patterns with the client pattern.
- For each benchmark pattern, we select the alpha and beta parameters for each age such that the ATA = (Alpha + Beta) / Beta. The total value of Alpha + Beta can be customized depending on the informative power of the prior pattern.
- You must also select a variance / mean ratio (scale parameter ϕ). A small value will result in more weight given to the client data because it implies a small process variance. This can be estimated empirically from the triangle, or from other sources.

Credibility In Loss Development

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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

	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - Ult
Client Pattern								
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

Credibility In Loss Development

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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
Client Pattern								
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

Credibility In Loss Development

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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 LogLikehood	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	

Credibility In Loss Development

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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	

Credibility In Loss Development

PartnerRe

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

Credibility In Loss Development

PartnerRe

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

AY	On-Level Premium	Exposure Trend	Trended OLP	LDF	Premium / LDF	500K xs 500K Reported	Severity Trend	Frequency Trend	Policy Limit Drift	400K xs 100K 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**

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Actuarial Overconfidence

Data Processing vs. Analysis – Actuarial Overconfidence

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Processing: formatting data and populating models

- Actuaries are “attached” to their pricing models
- Familiarity albeit “known bugs”

Analysis: making sense of the numbers

- Not just providing a numerical result but also asking the right questions throughout the pricing process
- Communicating uncertainties around the answer to all stakeholders
- Stress-testing results by varying key assumptions

Conger & Lowe “Managing Overconfidence” (2003)

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Actuarial Overconfidence – Exposure Rating

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- Last year's profile vs. this year's profile
- Last year's gross loss ratio vs. this year's gross loss ratio
- What is not included in the exposure rate? For example, ECO/XPL in casualty treaties
- Reasonableness of the curve for the underlying portfolio
  - US: Industry Curves, Client specific ILFs, Curve fit to data
  - Non-US: Swiss Re curves, Power curves, Lloyd's industrial curve

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Actuarial Overconfidence – Experience Rating

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- Claims movements in the layer vs. last year's selected LDFs
- Actual vs. Expected
- Rate changes
  - Cedant vs. market statistics by class of business
  - Estimated last year vs. actual achieved – consistently worse than estimated?
  - How are the rate changes calculated? Do they include claims inflation? Exposure adjustments?
- Other loadings – ECO/XPL, Cat loads, "free layer" adjustment

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Best way to manage overconfidence: institutionalize pricing & UW control cycle

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Pricing and underwriting process elements

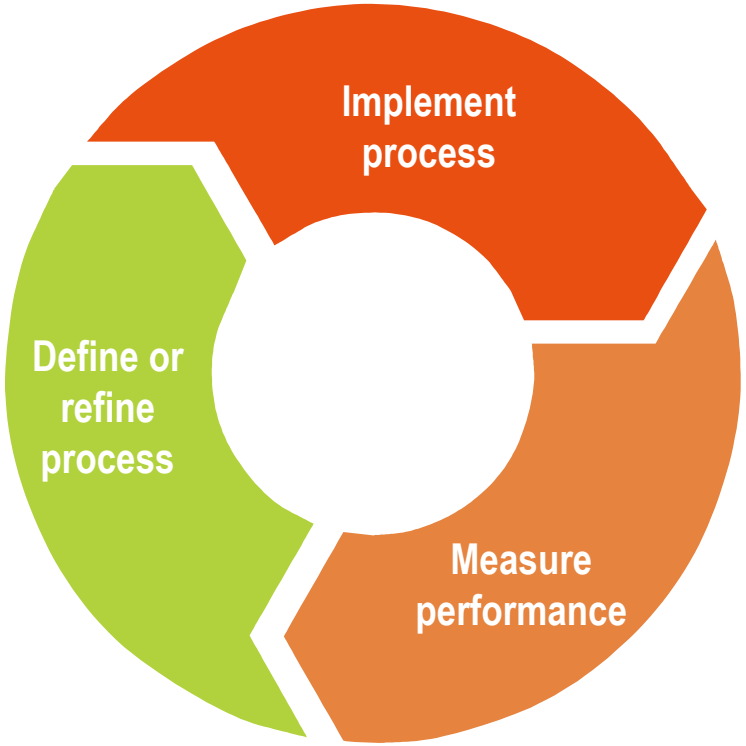
Data requirements

Actuarial methods employed

Underwriting policies and rules

Decision authorities and monitoring

Quality assurance



Formal retrospective performance testing

Data accurate and adequate?

Pricing methods sufficiently robust?

Policies and rules effective?

Decision authorities appropriate?

Variances between projected and actual experience within tolerances?

Source: CAE Zurich 2004 – Doug Collins-Tillinghast-Towers Perrin (Adapted and used with permission from Willis Towers Watson)

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Overconfidence (374 actuarial respondents-2012)

PartnerRe

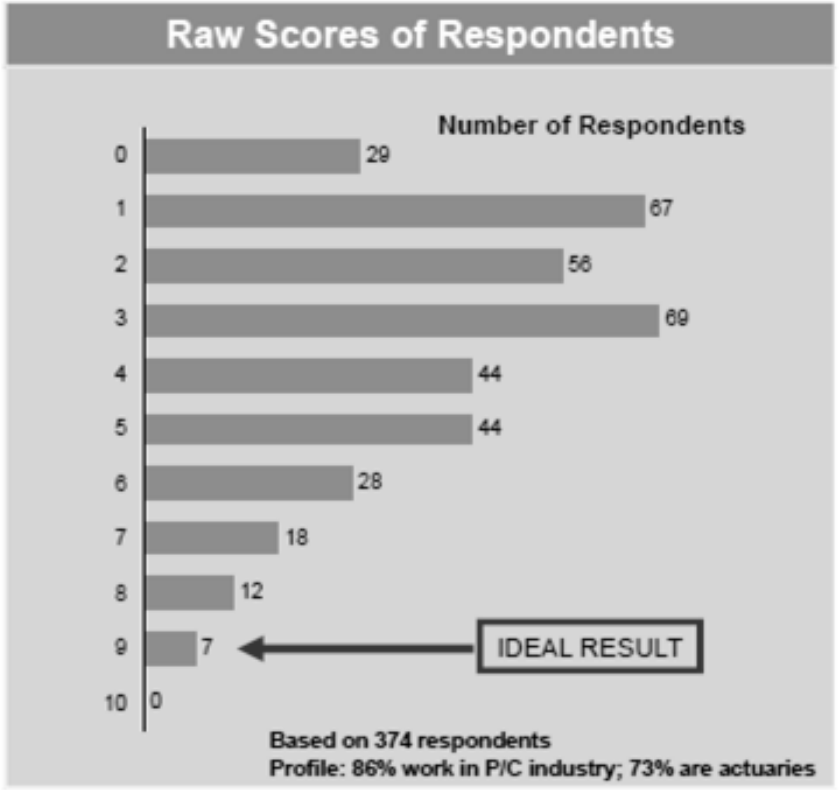
Metaknowledge = understanding of the limits of knowledge

- "Known unknowns" and recognition of "unknown unknowns"

We humans tend to believe we know much more than we do

  - Development of metaknowledge not typically part of formal education
  - Metaknowledge is rarely recognized or rewarded in practice

- Underwriters and actuaries are not immune!
  - Towers Watson "Confidence Quiz"



Steve Lowe, CARe 2012

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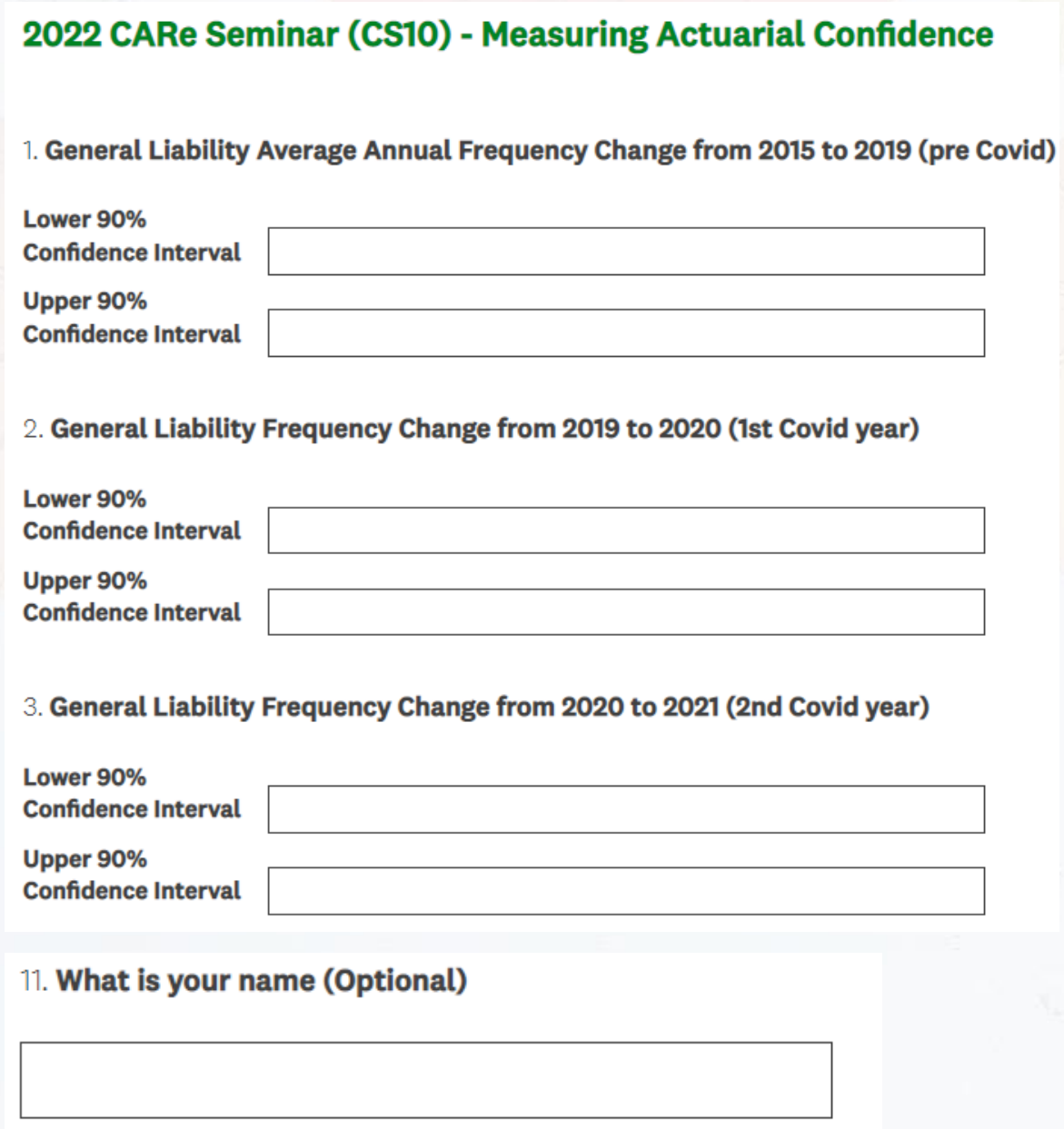
Measuring Confidence – Covid/Inflation Trends – Qs TBD



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 are **asking 10 Qs** via Survey Monkey that will be left up during the course of David and Shani's CS10 presentations. **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.

"Answers" will be presented at the end of Shani's section. You can answer either **anonymously, or provide your name** at the end.

Measuring Confidence answers, comparing aggregated confidence interval ranges to the "Answers", will be provided in the **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.

Questions and Feedback…

PartnerRe

Presenter:

David Fairchild, VP Managing Actuary

David.Fairchild@partnerre.com

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PartnerRe

How Understanding Civil Unrest, Social Inflation, Covid and Recent Inflation Trends can Prepare You for 2022 and 2023

Shani Clarke
Actuarial Consultant
Verisk Underwriting Solutions UK

13/06/2022

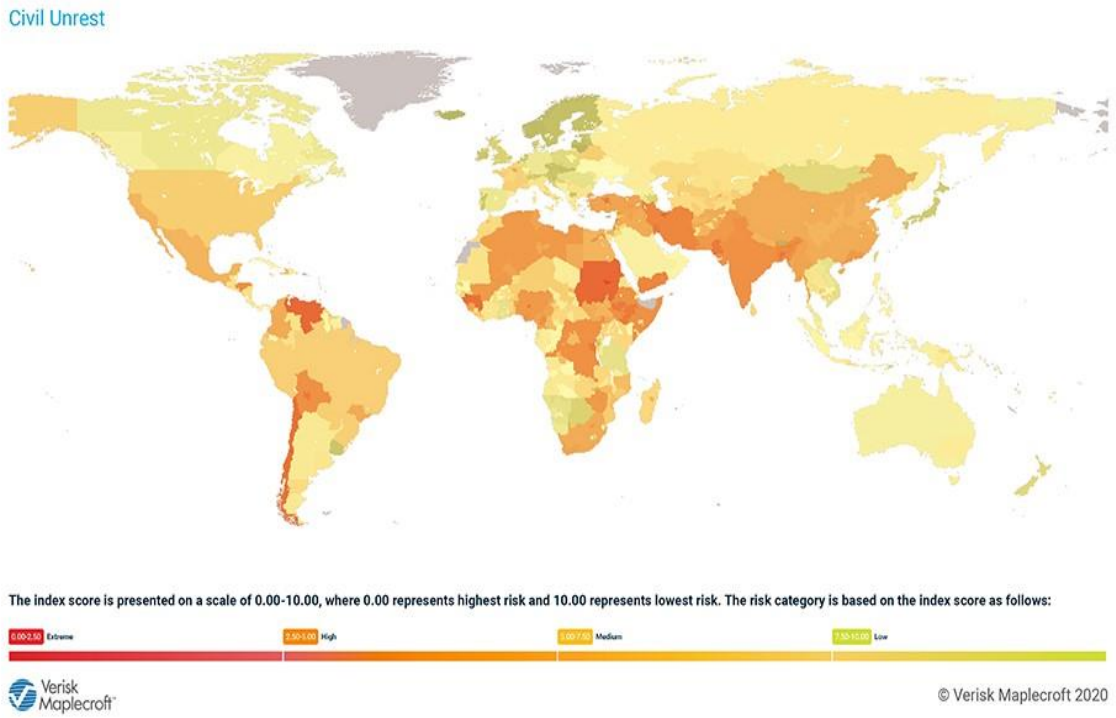
Agenda

1. Civil Unrest
2. Social Inflation
3. Covid
4. Inflation
5. Recent Impacts

Civil Unrest Section 1

The Maplecroft Civil Unrest Index

The Civil Unrest Index quantifies the risk of disruption to business caused by any incidents of unrest ranging from protests to rioting in 198 countries.



Civil Unrest – The Main Drivers

- Political polarization and distrust in the legitimacy of the electoral process

- Divisions over criminal justice and police reform

- Income inequality

The Impact on Insurers

2020 losses were heavily skewed by losses in May and June following the death of George Floyd and seemed the tail off at that point.

Businessowners Riot and Civil Commotion Losses

Year	Losses
2016	$51,015
2017	$315,783
2018	$102,029
2019	$660,097
2020	$153,479,388

© Verisk. Reported data is preliminary.

Commercial Property Riot and Civil Commotion Losses

Year	Losses
2016	$2,592,906
2017	$1,355,114
2018	$640,511
2019	$402,862
2020	$86,849,354

© Verisk. Reported data is preliminary.

The Impact on Insurers

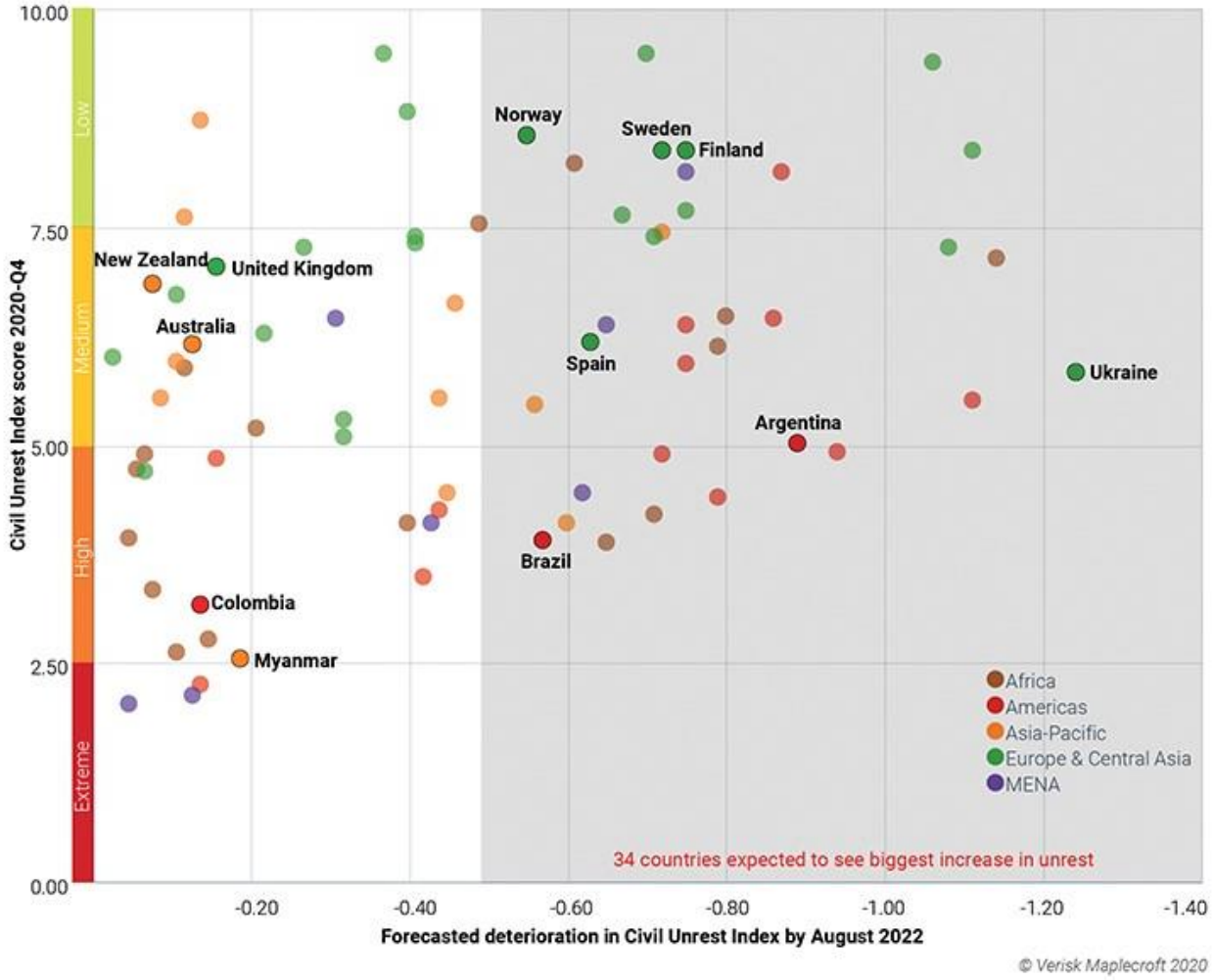
Protest activity was not localized to one state, the losses are seen nationwide.

Top 5 Statewide Percentage Increases – Commercial Property and Businessowners Combined

State	Average Riot and Civil Commotion (2016-2019)	Riot and Civil Commotion (2020)	Percent Change in Riot and Civil Commotion Losses
Illinois	$5,311	$64,946,337	1,222,822%
Wisconsin	$315	$1,629,802	517,297%
Massachusetts	$2,917	$7,668,183	262,824%
Georgia	$805	$2,113,302	262,340%
Kentucky	$363	$638,852	176,135%

© Verisk. Reported data is preliminary.

2022 and beyond



Social Inflation
Section 2

What is Social Inflation?

The increased costs of insurance claims resulting from:

- Larger jury verdicts

Driven by:

- Changes in the judicial landscape
  - Greater propensity to sue

Rise of social inflation | AGCS (allianz.com)

What is causing the changing loss experience?

Higher Jury Awards

- Upward trends in jury awards
- Distrust towards large corporations
- “Deep Pocket Syndrome”
- Use of Analytics

Evolving Loss Types

- Traumatic brain injury
- Medical advances

Court Closures and Settlement Trends

- Uncertainty around court reopening
- Delays in cases proceeding
- Increase in settled cases

What is causing the changing loss experience?

Workers' Compensation Claims

- Increasingly more generous

Tort Reform

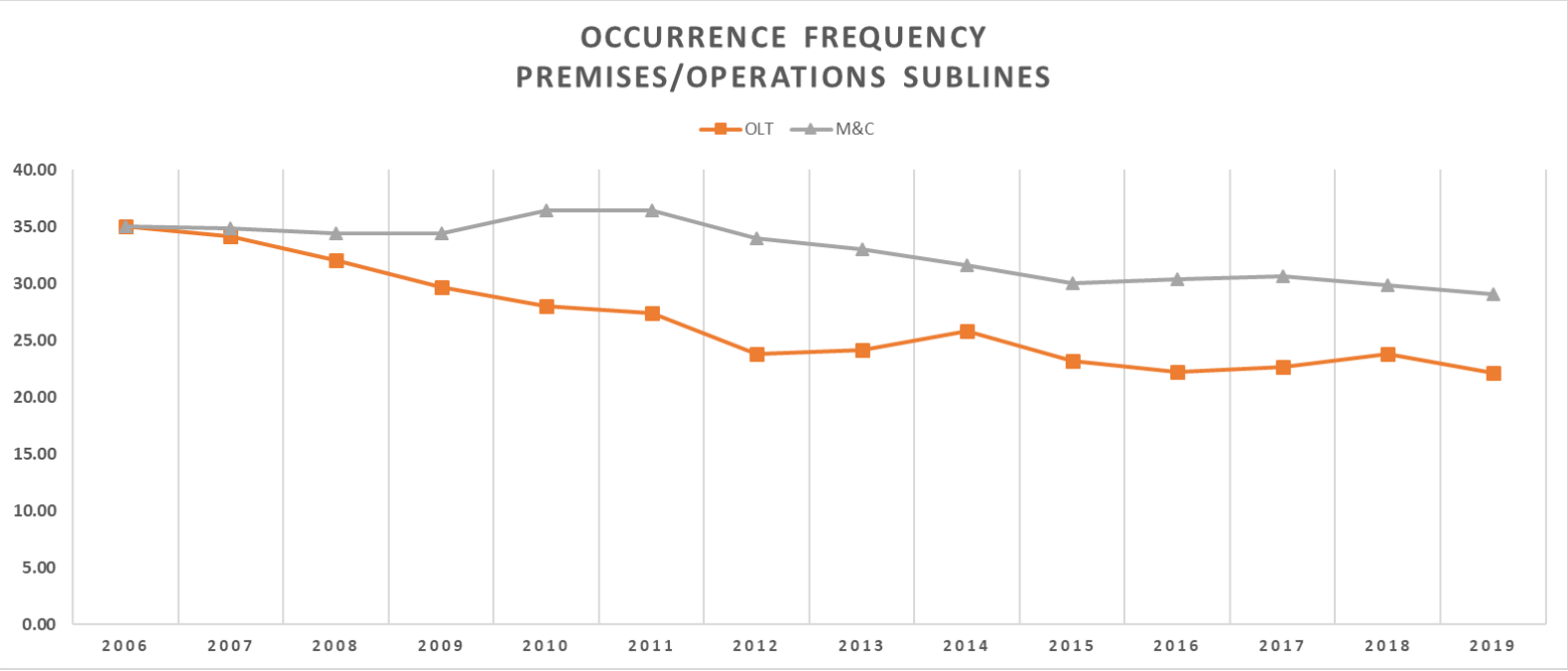
- Tort reform rollback including:
  - Non-economic damage caps
  - Punitive damages reforms

Litigation Financing

- 3rd party financing
- Non-Recourse Loan, Loans to Plaintiff, Investment types.

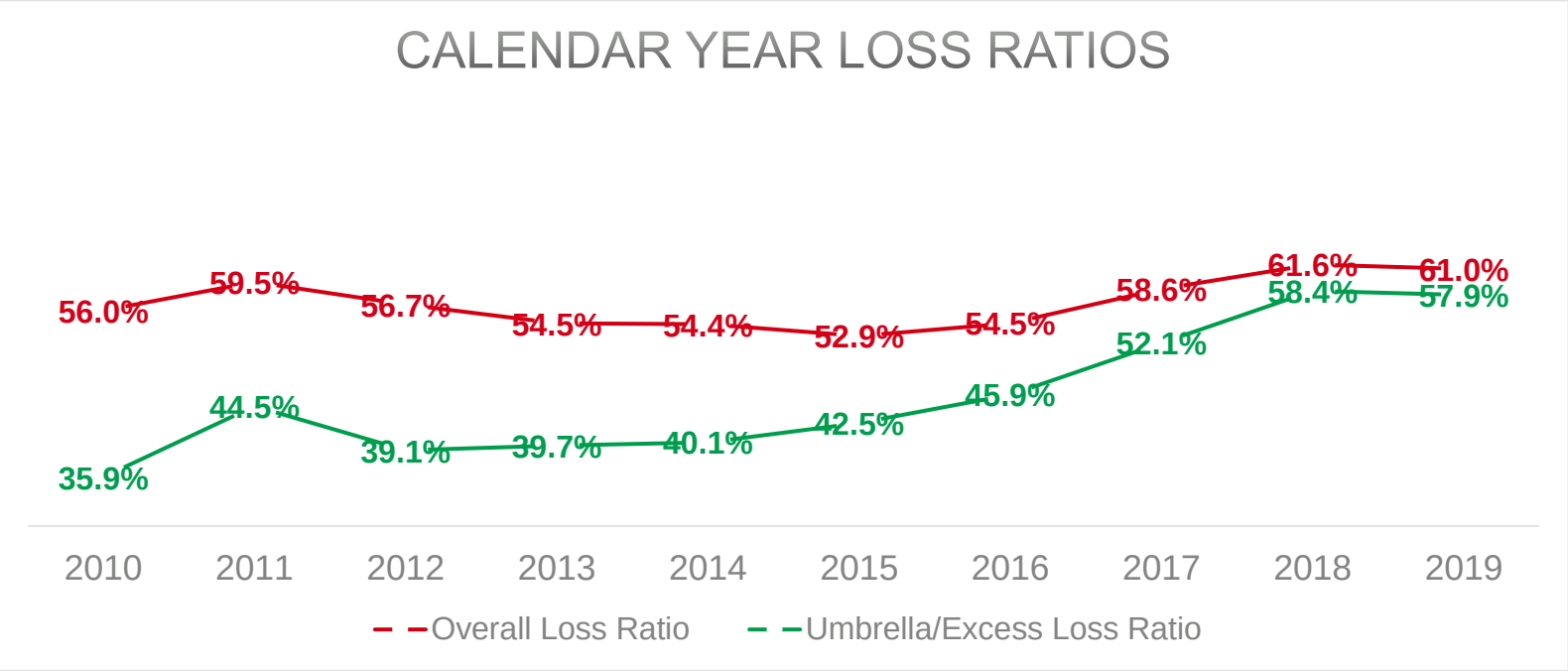
What the data shows us?

General Liability – Premises/Operations Accident Year Occ. Frequency



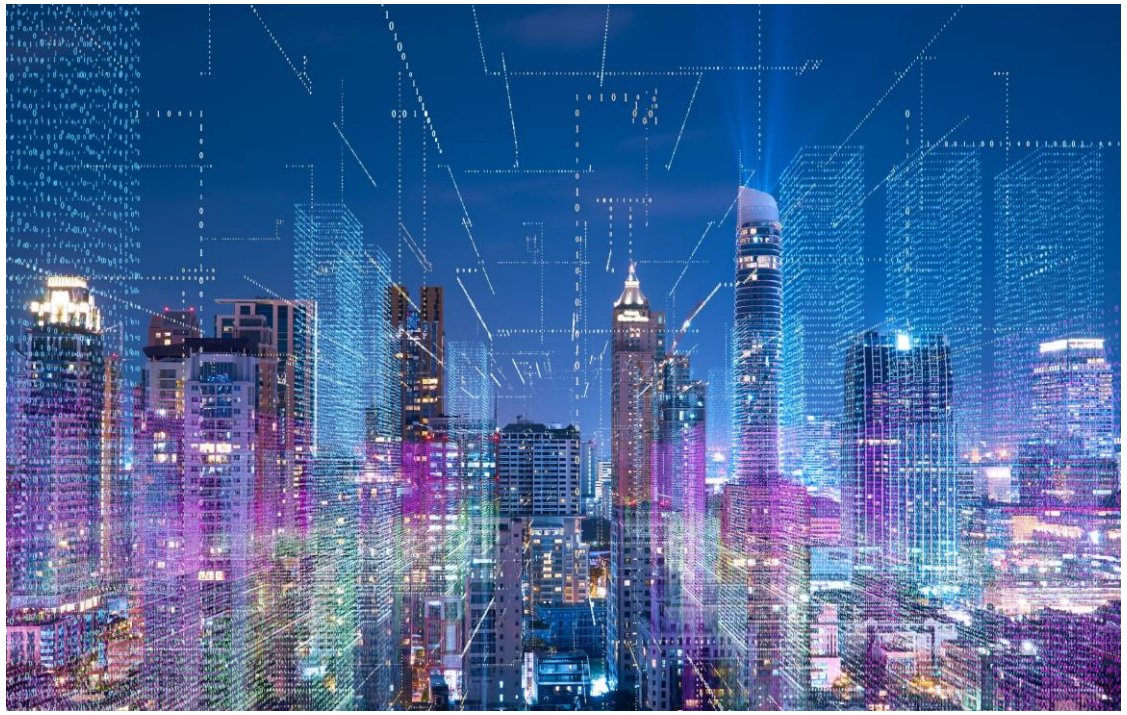
What the data shows us?

Overall General Liability vs Commercial Umbrella/Excess loss ratios



How can insurers respond?

- **Data Analytics and Predictive Modelling**
- **Exposure Modelling**
- **Product**

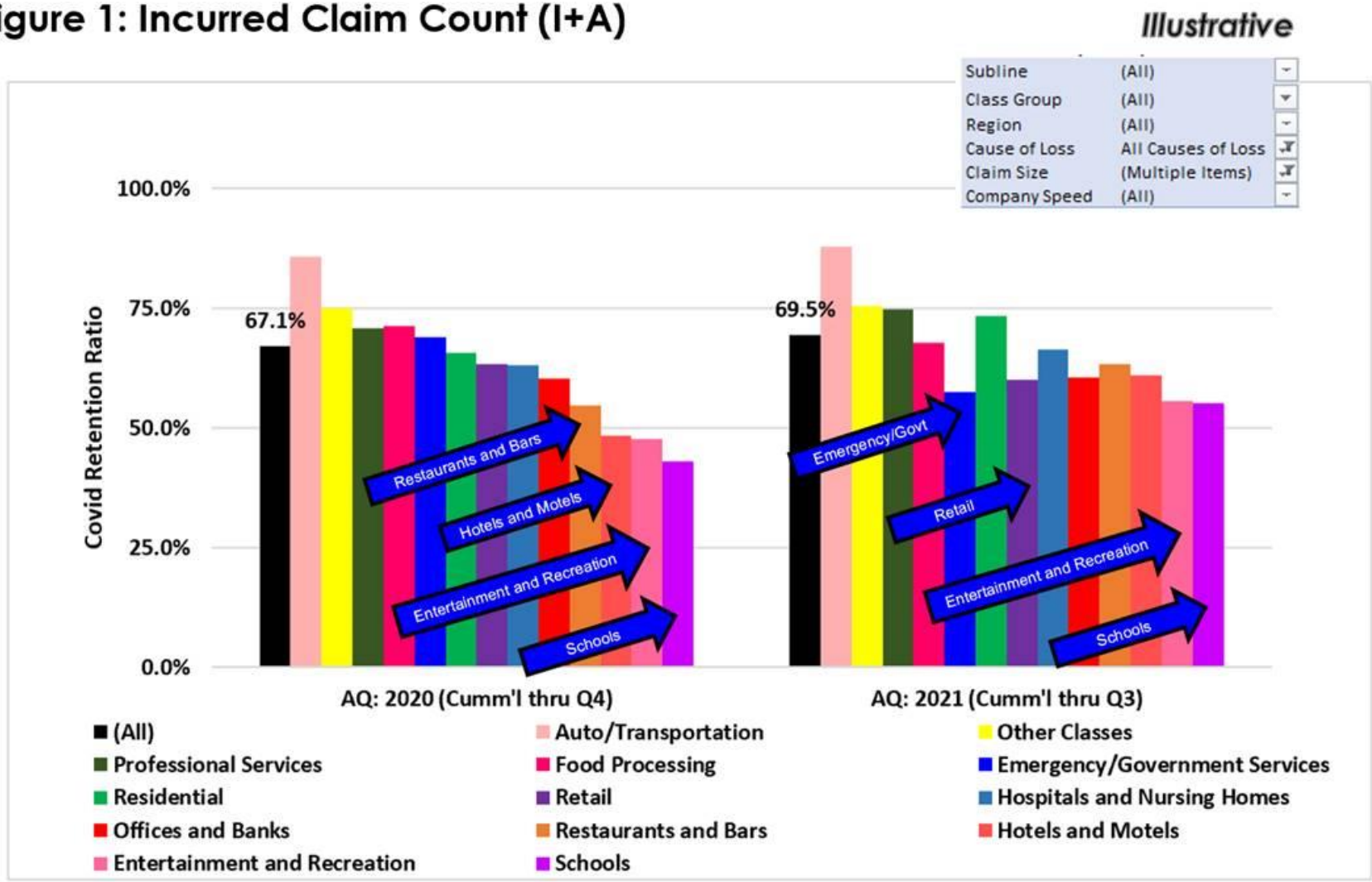


Covid Section 3

General Liability – Class Groups

Incurred Claim Count by Class Group

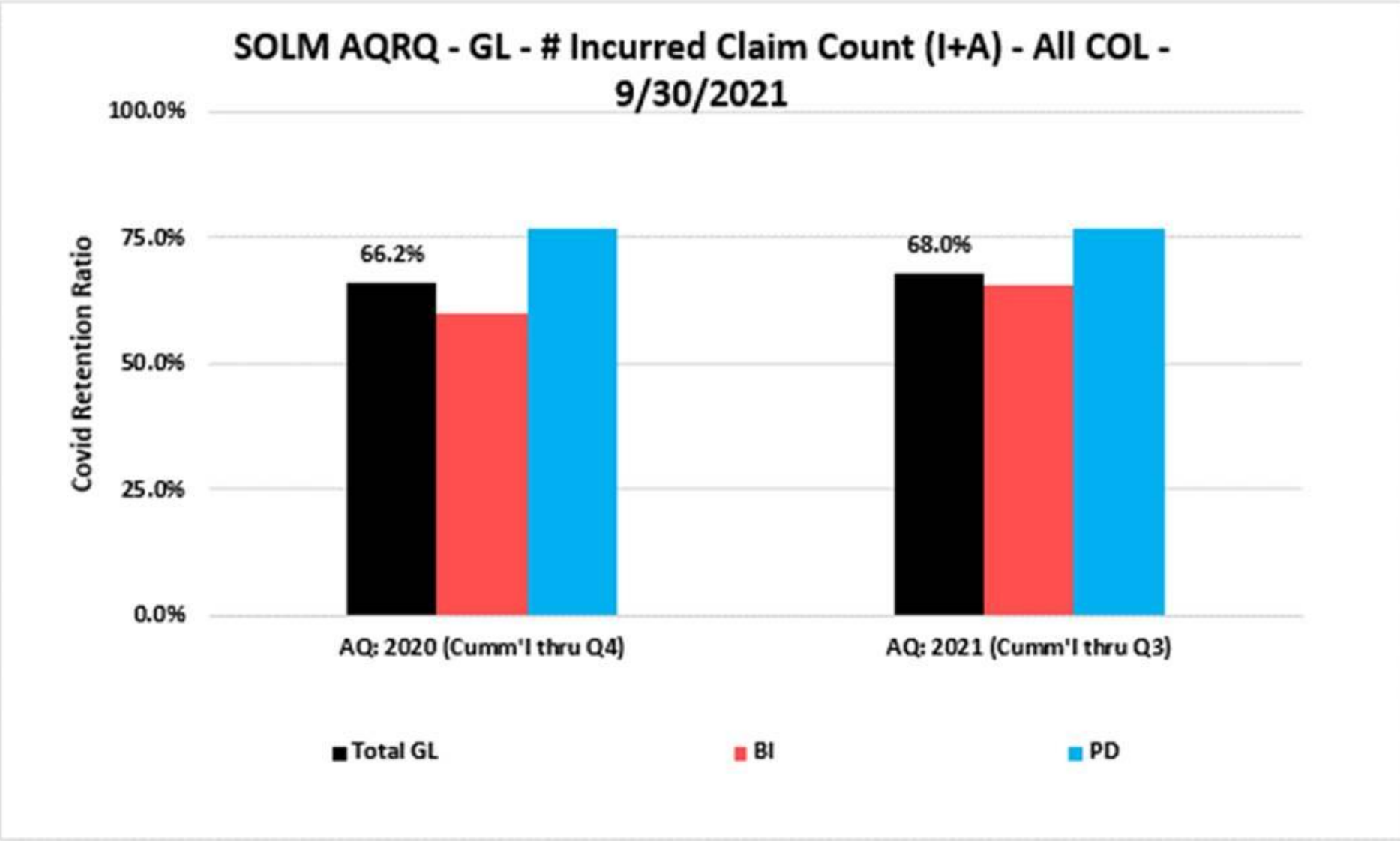
Figure 1: Incurred Claim Count (I+A)



Source: ISO SOLM – AQRQ, data through 9/30/2021

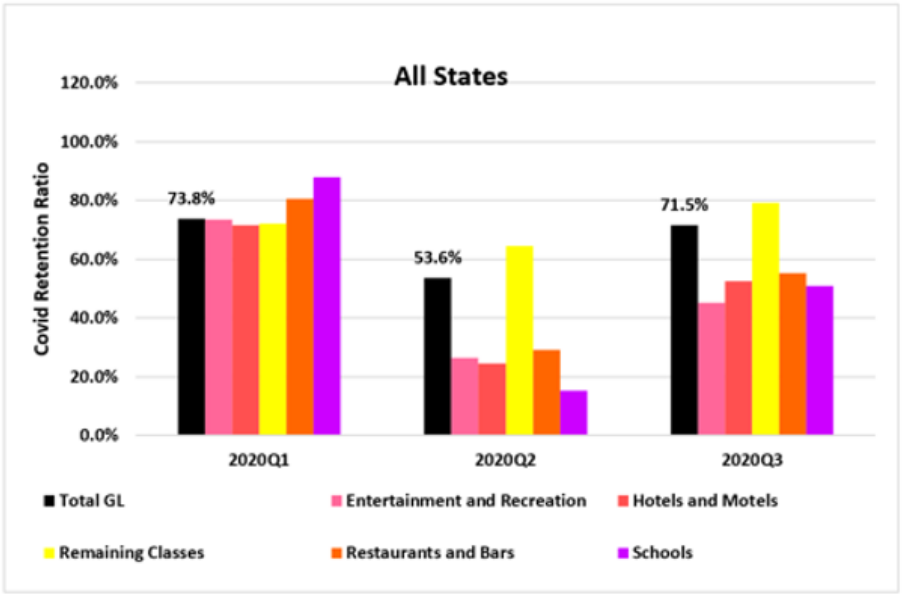
General Liability – Cause of Loss

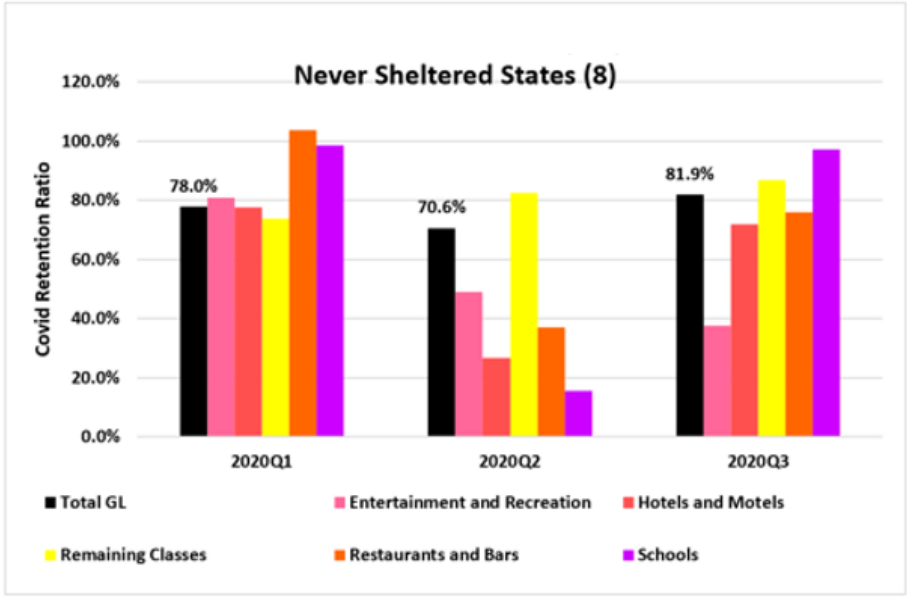
Incurred Claim Count by Cause of Loss



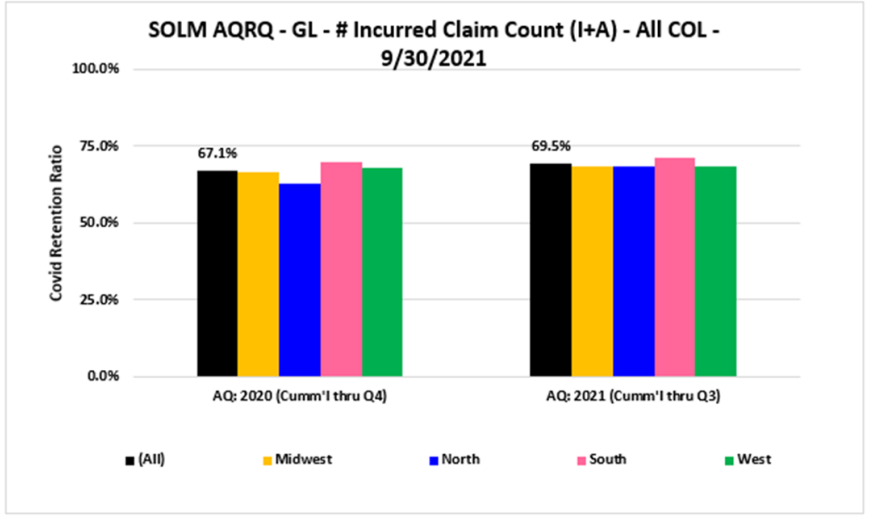
General Liability – State Group

Incurred Claim Count by State Group





Source: ISO SOLM – AQRQ, data through 9/30/2020



Considerations

Digitisation of the Market

Challenges

- Cyber-related exposures
- Effectiveness of distribution channels
- Fraud

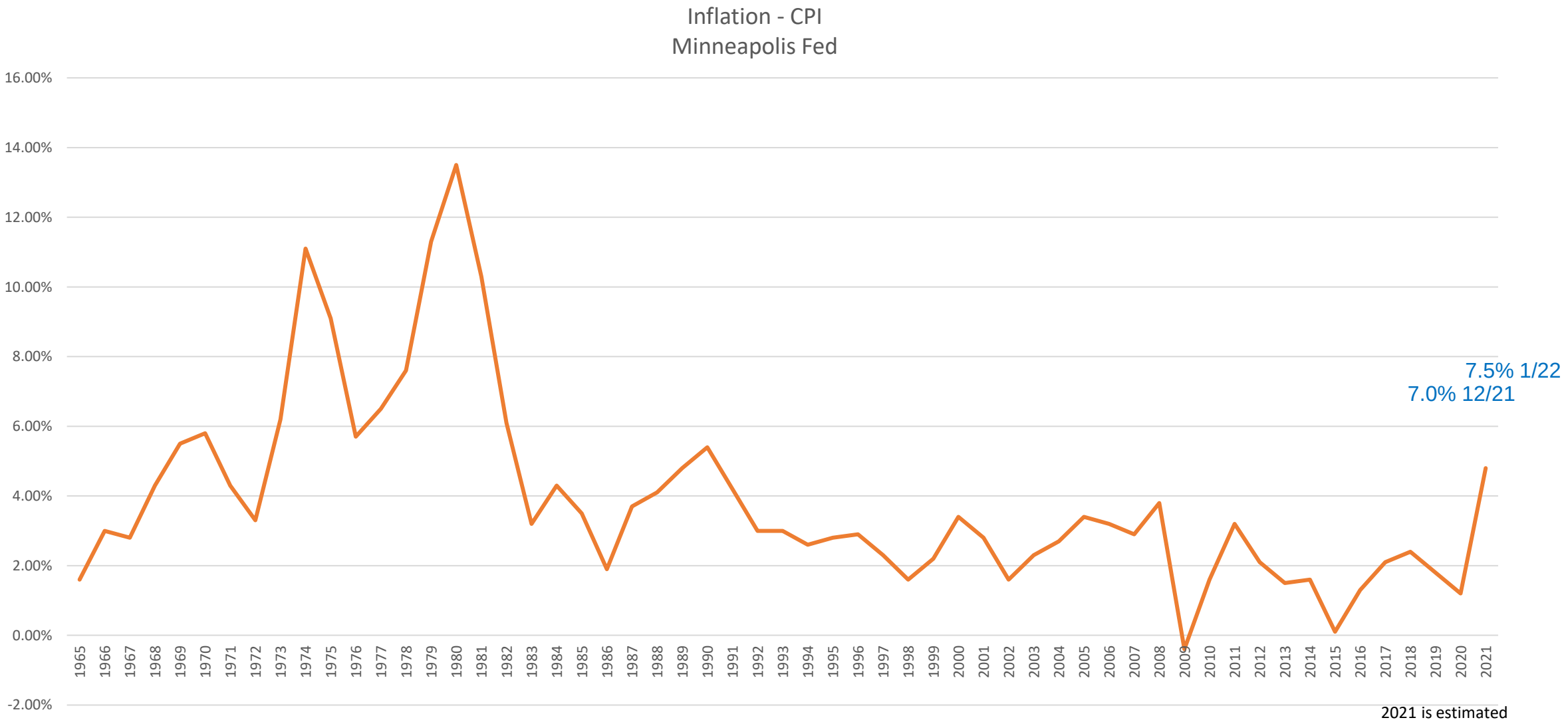
Opportunities

These can be found at several distinct parts of the value chain:

- Pricing Models
- Underwriting Process
- Claims Handling
- Customer Experience and expectations
- Detect and Manage Fraud

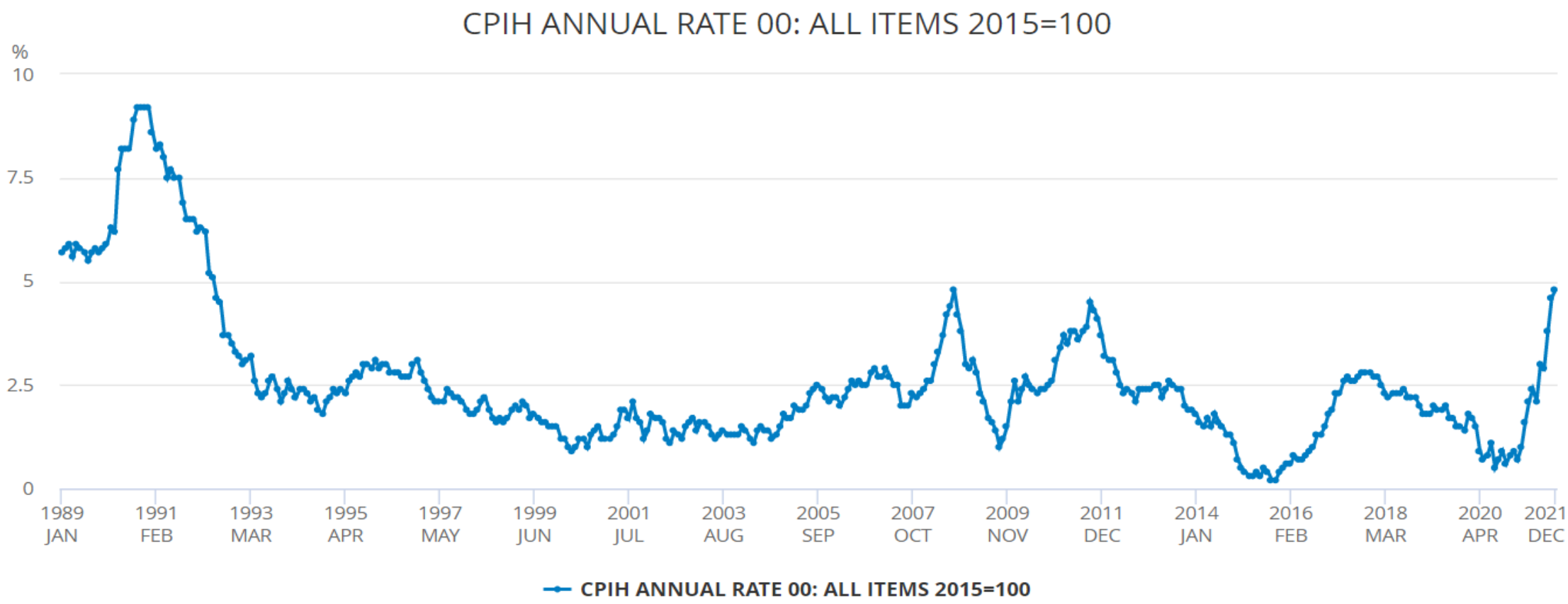
Inflation
Section 4

Historical USA inflation rates – 2021 estimated July 2021



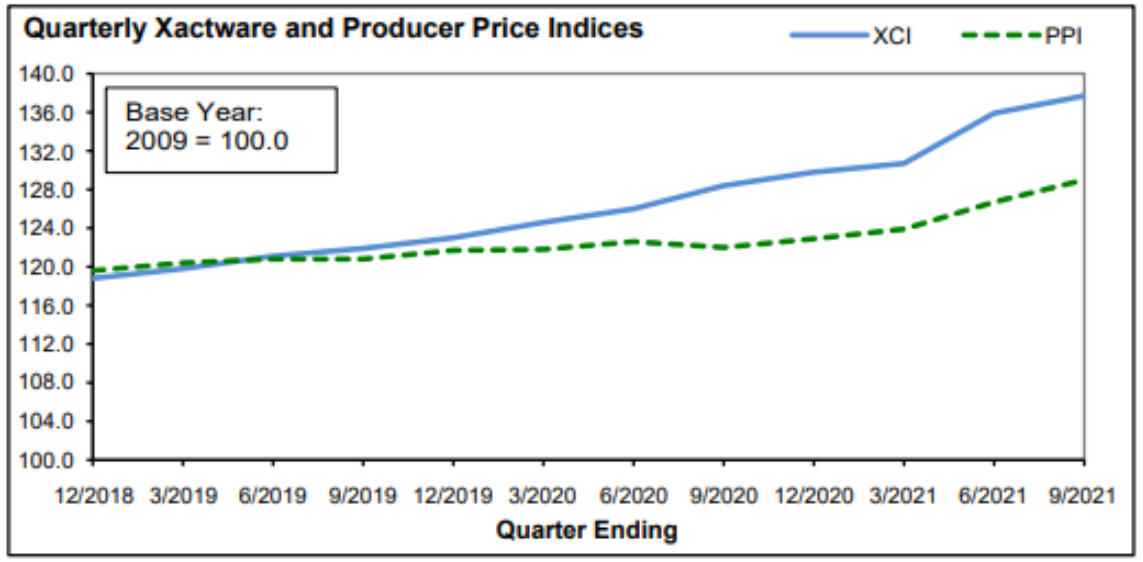
Historical UK inflation rates

Inflation - CPI
UK Office for National Statistics
Through December 2021

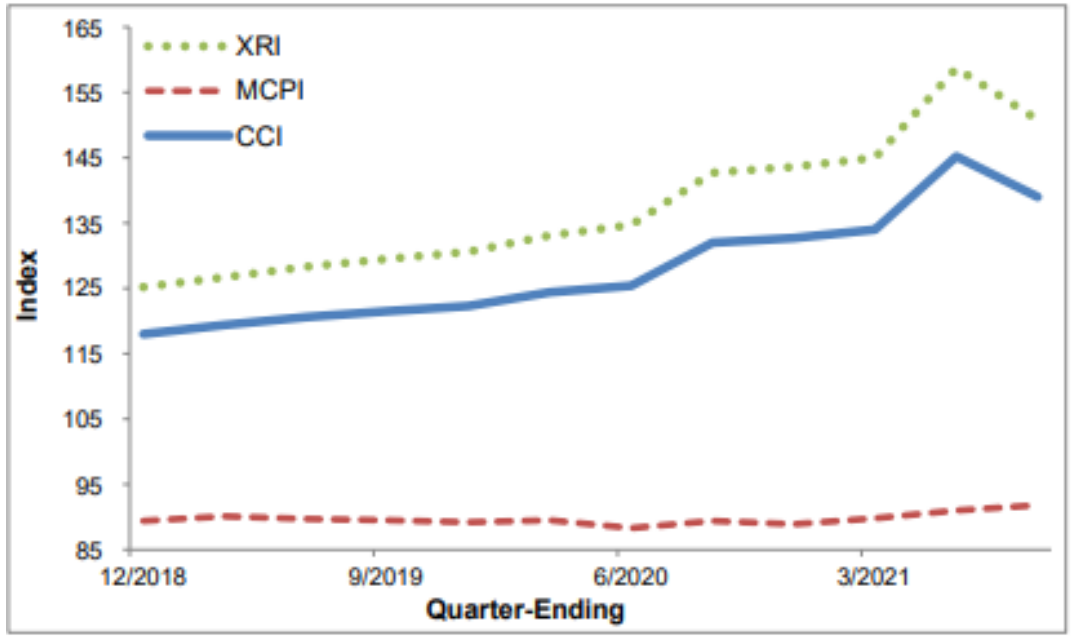


Construction costs

Commercial trend



Residential trend



Why volatility in Residential?

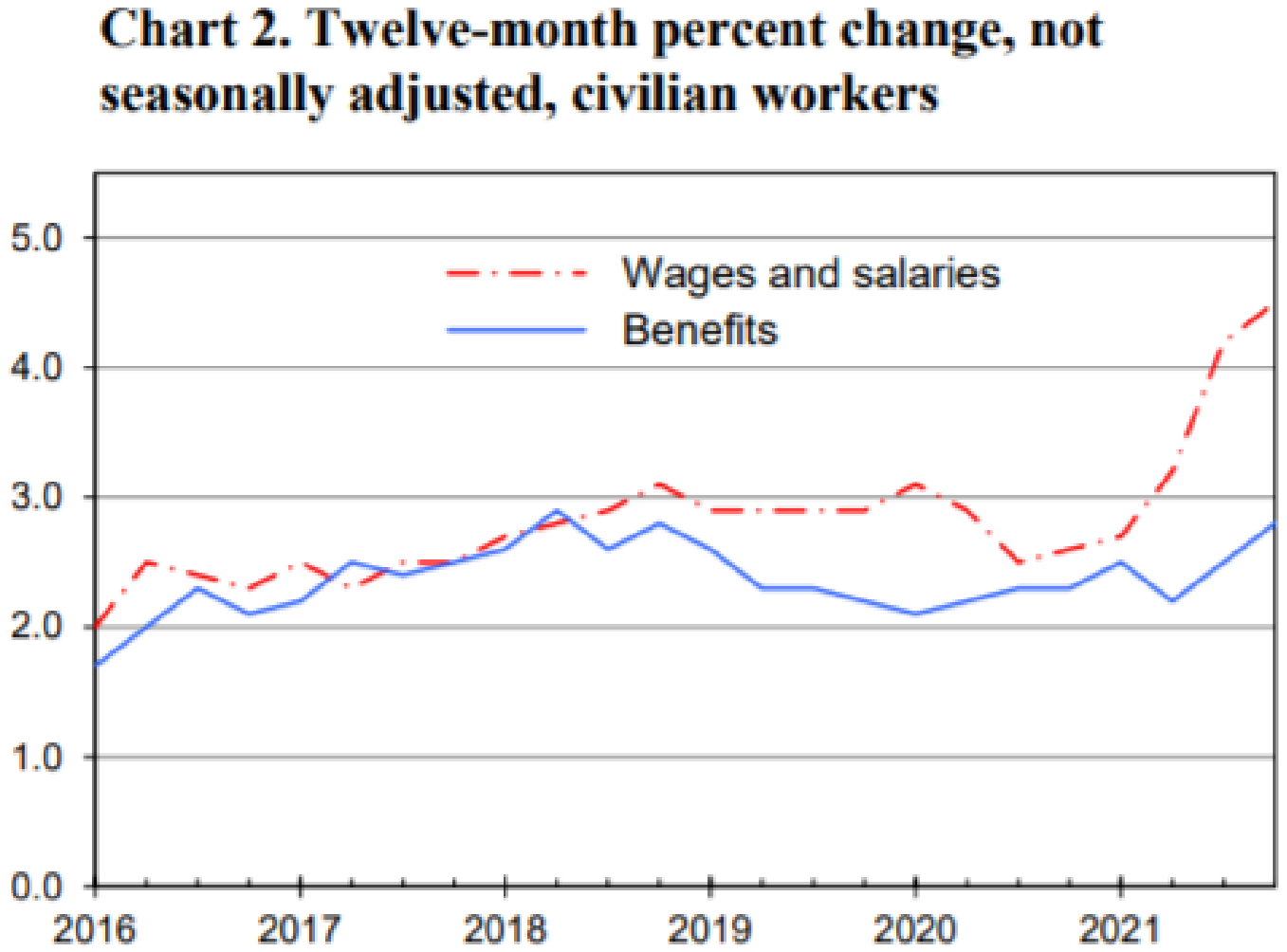
- Lumber vs. Steel & Concrete
- Higher labor prices for Commercial – more stable (at the moment!)
- Building finishing (Elevators, Sprinklers, etc.)

Wage Inflation – BLS December 2021

4.0% increase year over year

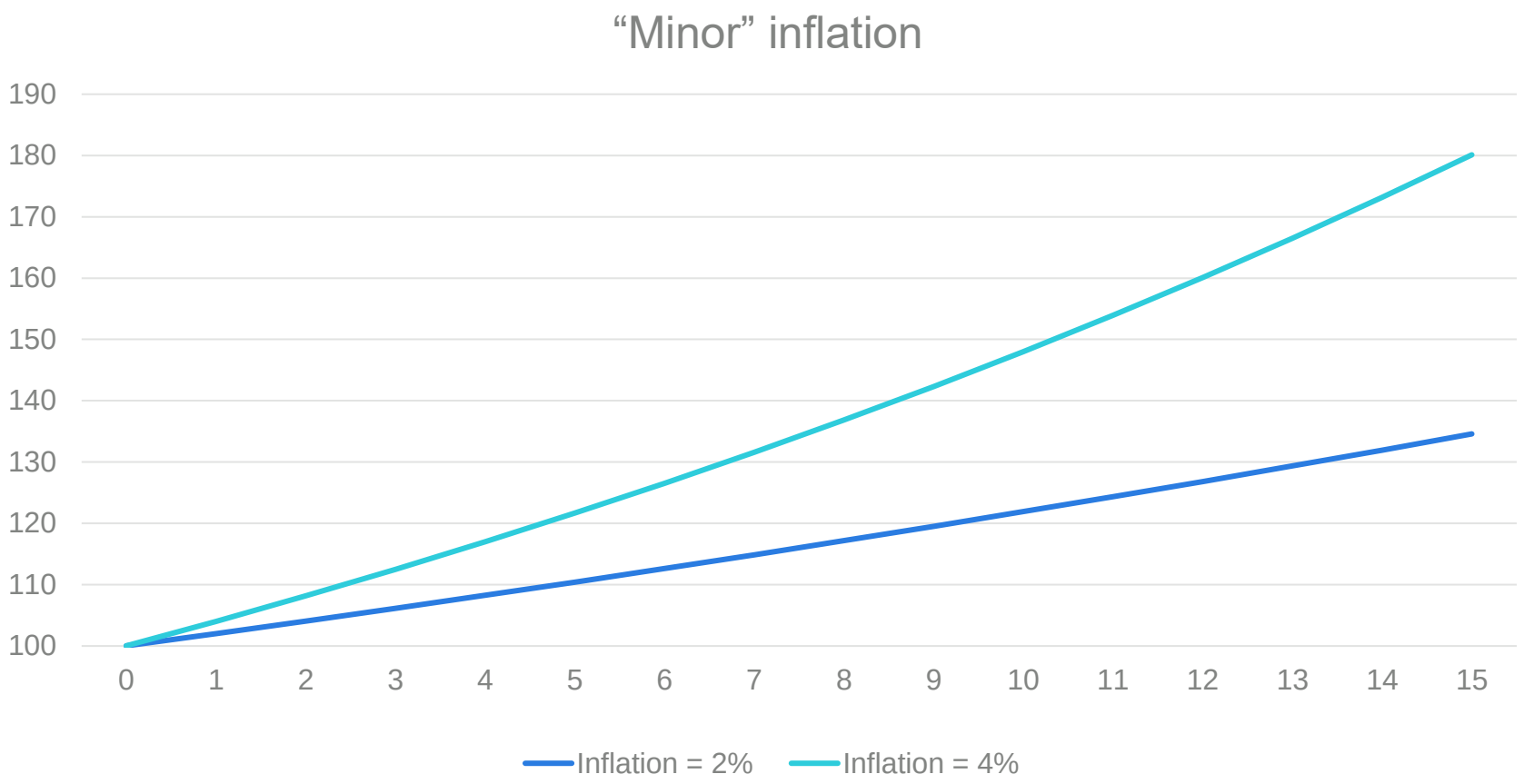
Highest in 20 years

U.S. Bureau of Labor and Statistics



Effects of “minor” inflation

Consider the difference between 2% inflation and 4% on a long-tailed line, with a 15 year horizon



Effects of “minor” inflation

Consider the hypothetical difference between 2% inflation and 4% on a long-tailed line, with a 15-year horizon

Assume a UK insurer with “fully reserved” claims on a nominal and expected inflation basis

Expected year of payments Year 0	Nominal (today’s date) Pound Sterling of expected ultimate loss	Reserved expected ultimate loss with 2% inflation assumption	Actual loss payments given realized 4% inflation	Difference
Year 2	£4M	£4.16M	£4.33M	£0.17M
Year 4	£3M	£3.25M	£3.52M	£0.27M
Year 6	£4M	£4.5M	£5.07M	£0.57M
Year 8	£6M	£7.03M	£8.24M	£1.21M
Year 10	£12M	£14.63M	£17.83M	£3.2M
Year 12	£10M	£12.68M	£16.08M	£3.4M
Year 14	£5M	£6.6M	£8.71M	£2.11M
Totals	£44M	£52.85M	£63.78M	£10.93M

Recent Impacts
Section 5

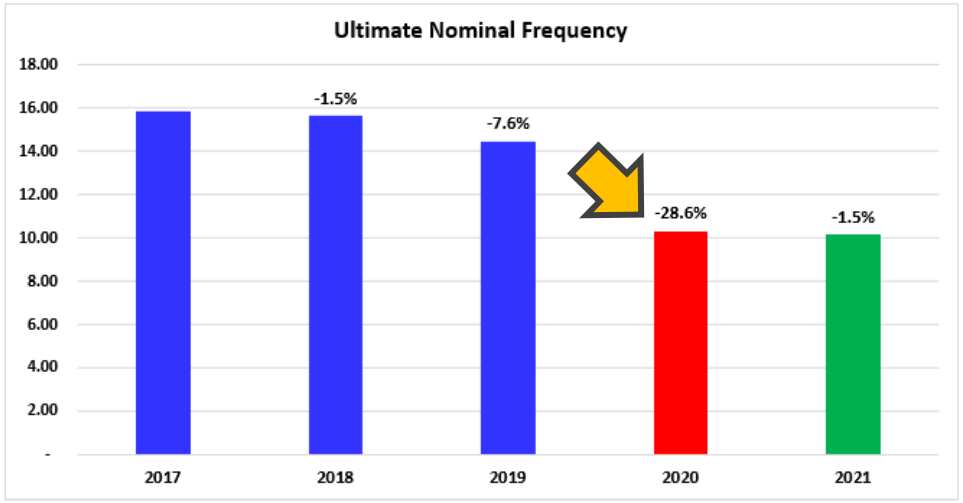
Recent Trends Impacted by Covid / Inflation – Total GL 2017 through 2021 Year-End (Preliminary)

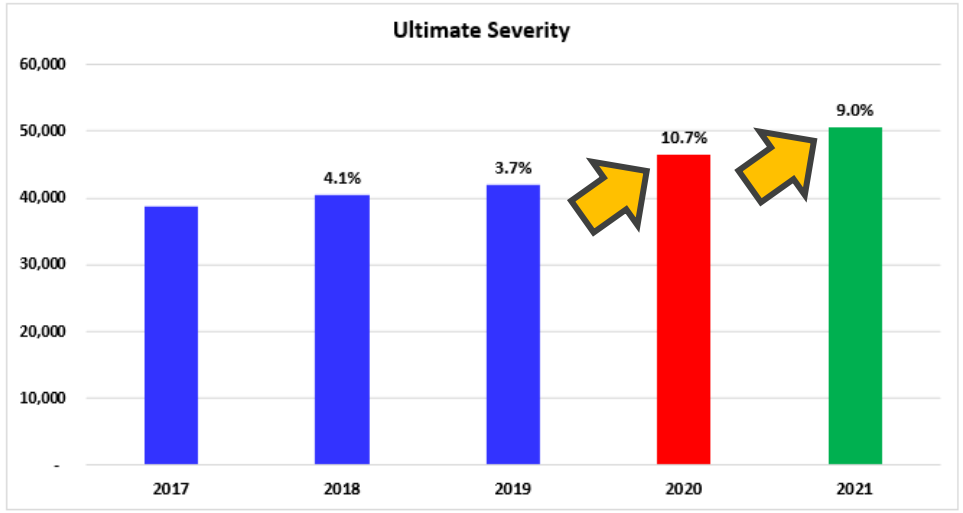
Verisk™ Illustrative

GL showed a 29% frequency reduction in 2020 due to Covid, with similar depressed level in 2021. Average severities increased in 2020 and 2021 by 11% and 9%, compared to the 4-5% trends that we have 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 2022 and beyond**





ISO SOLM QTR

SOLM Qtr GL 2021 Q4
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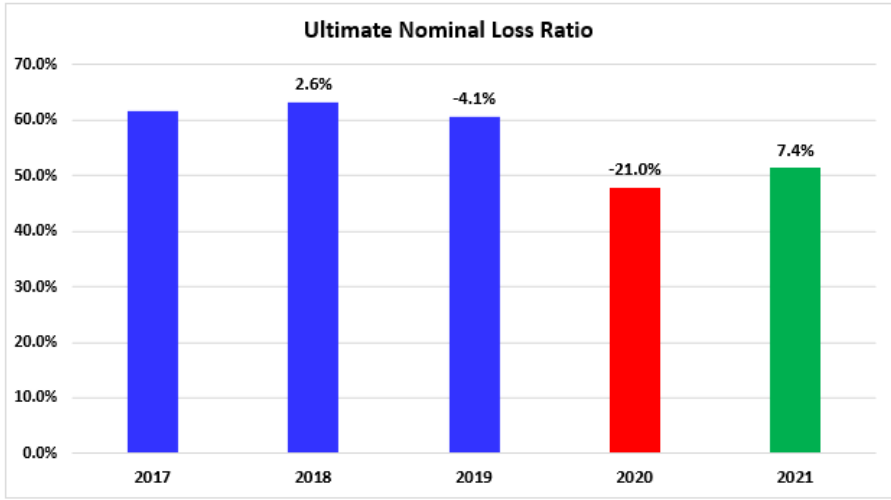
Subline	PremOps | Products | Other
Class Group	GL-Comp Op | GL-Contr | GL-CRR | GL-Lcl Prd | GL-Liquor | GL-Mfg | GL-OLT | GL-Pollution | GL-Prod
Region	Countrywide
Cause of Loss	All Causes of Loss
Claim Size	1 - <10k | 10k - <25k | >= 25k
Company Speed	Faster | Slower



CvRR

	Claim Count	Severity	Premium
2020	0.669	1.152	0.990
2021	0.673	1.261	1.017
2022	?	?	?

# of Claims (5 years) **580,607**

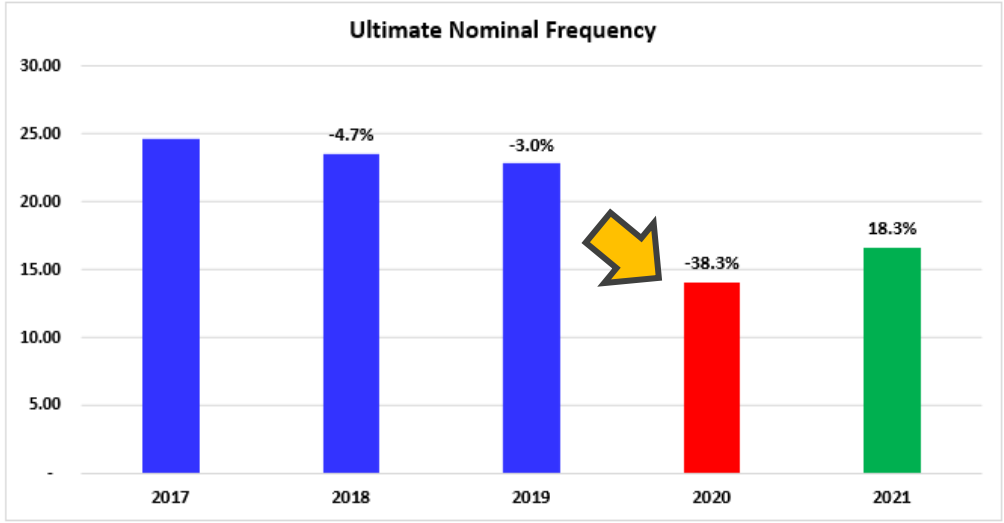
NB: mechanical selection for LDFs of last 7 qtr VWA used in projections from GL SOLM-Qtr at 12/31/2021. No tail beyond 2017 supplied.

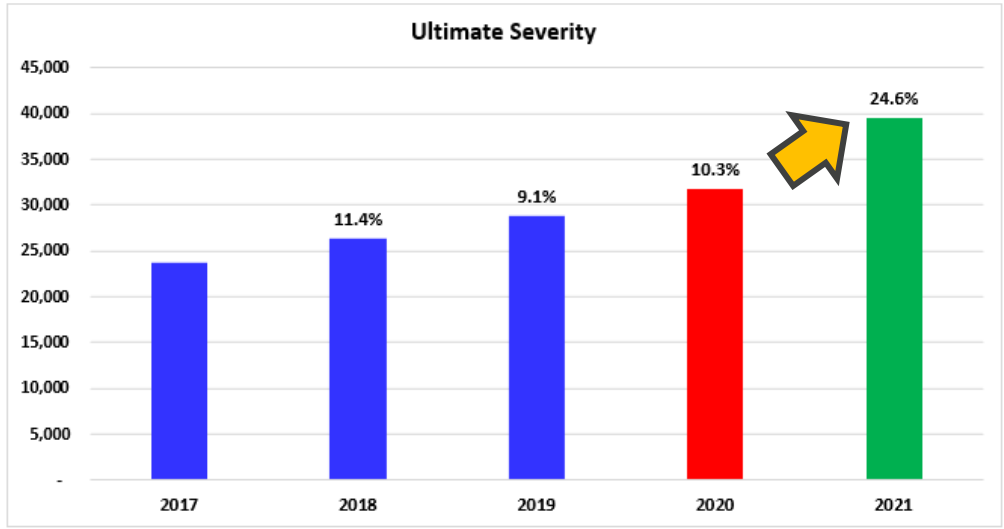
Recent Trends Impacted by Covid / Inflation – GL Restaurants & Bars 2017 through 2021 Year-End (Preliminary)

Verisk™ Illustrative

This annual view of the quarterly data shows the YTY changes for frequency, severity, and loss ratio from 2017 through year-end 2021.

The large frequency reduction in 2020, has been offset by partial frequency increase and a large increase in severity for 2021. The average severity increase of around 10% for each of the last 3 years, has increased to almost 25% in 2021. The heightened recent inflation may cause a floor on settlements, potentially impacting results in 2022 and beyond





ISO SOLM QTR

SOLM Qtr GL 2021 Q4
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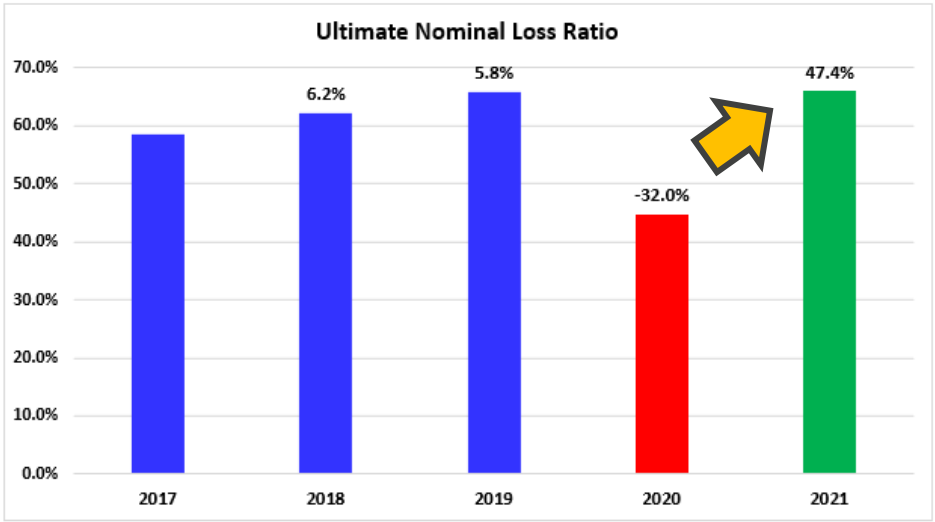
Subline	PremOps | Products
Class Group	Restaurants and Bars
Region	Countrywide
Cause of Loss	All Causes of Loss
Claim Size	1 - <10k | 10k - <25k | >= 25k
Company Speed	Faster | Slower



CvRR

	Claim Count	Severity	Premium
2020	0.544	1.178	0.907
2021	0.642	1.406	0.923
2022	?	?	?

# of Claims (5 years) 38,135

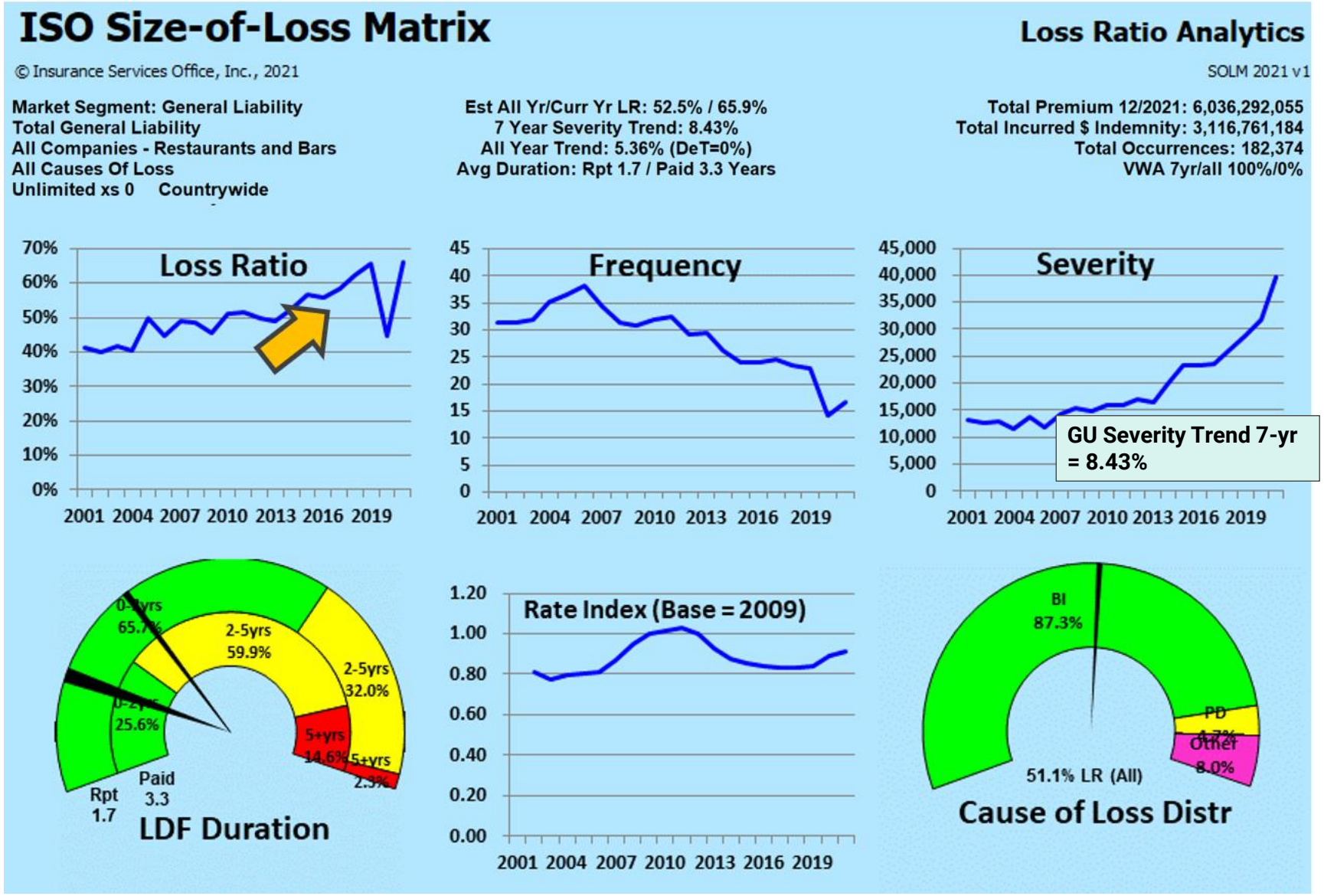
NB: mechanical selection for LDFs of last 7 qtr VWA used in projections from GL SOLM-Qtr at 12/31/2021. No tail beyond 2017 supplied.

3. SOLM Infographic – GL Restaurants & Bars
Updated through 12/31/2021 (Preliminary)

Verisk™
Illustrative

This exhibit shows the holistic analysis using standard SOLM Infographic, showing the combined impact of frequency and severity trends along with rate changes to produce on-level loss ratios. Note that for this category, the significant impact of Covid and inflation on the 2020 and 2021 loss ratios, primarily driven by a large reduction in frequency.

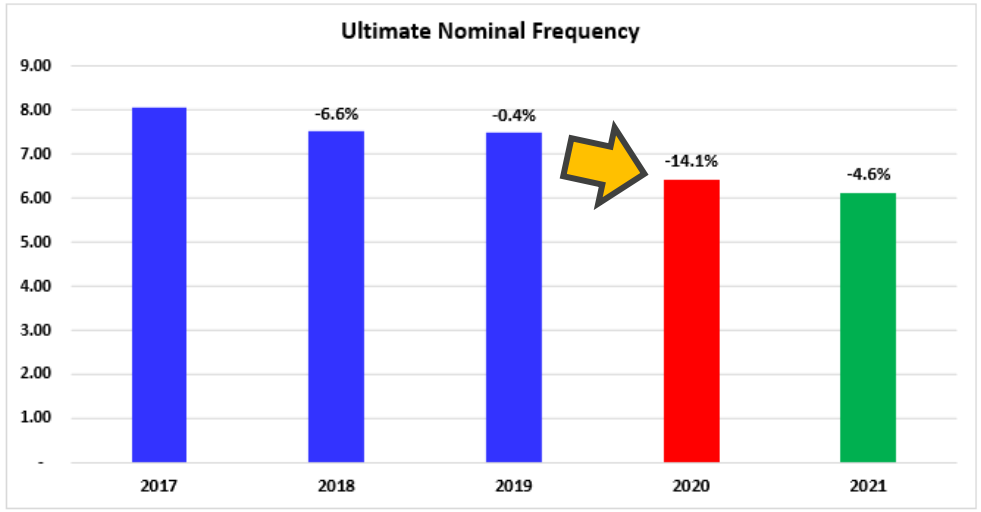
Additional analysis is needed to properly include the impact of Covid and inflation on parameter and loss ratio assessment, including making usage of industry average reductions due to Covid which may reverse in 2021 and 2022. If these Covid impacts to frequency begin to reverse, with heightened inflation, we could see a large rise in loss ratio in 2022.

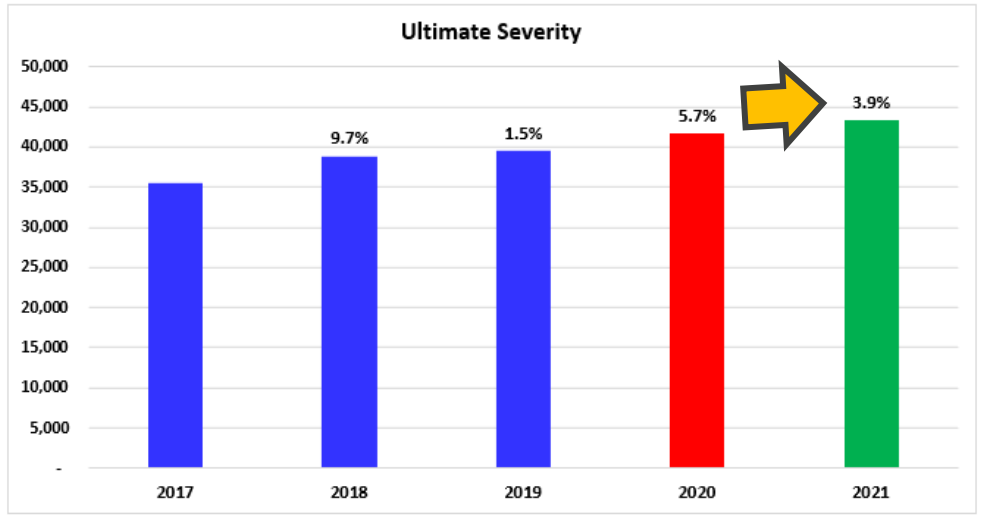


Recent Trends Impacted by Covid / Inflation – GL Products 2017 through 2021 Year-End (Preliminary)

Verisk™ Illustrative

Not every GL category saw the big increase in severity that we saw with Restaurants and Bars. Looking at Products markets, we saw only a moderate increase in severity with continuing decreases in frequency leading to slight further reduction in loss ratios.





ISO SOLM QTR

SOLM Qtr GL 2021 Q4
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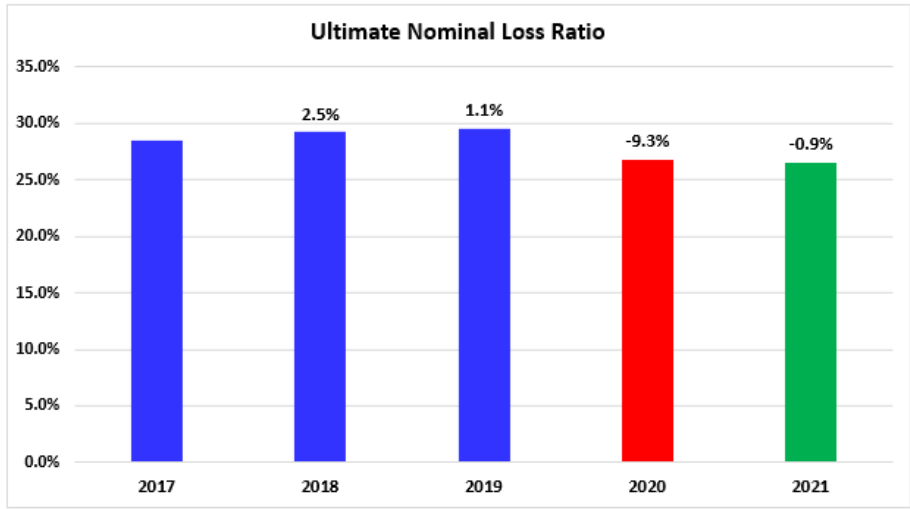
Subline	Products
Class Group	GL-Comp Op | GL-Lcl Prd | GL-Prod
Region	Countrywide
Cause of Loss	All Causes of Loss
Claim Size	1 - <10k | 10k - <25k | >= 25k
Company Speed	Faster | Slower



CvRR

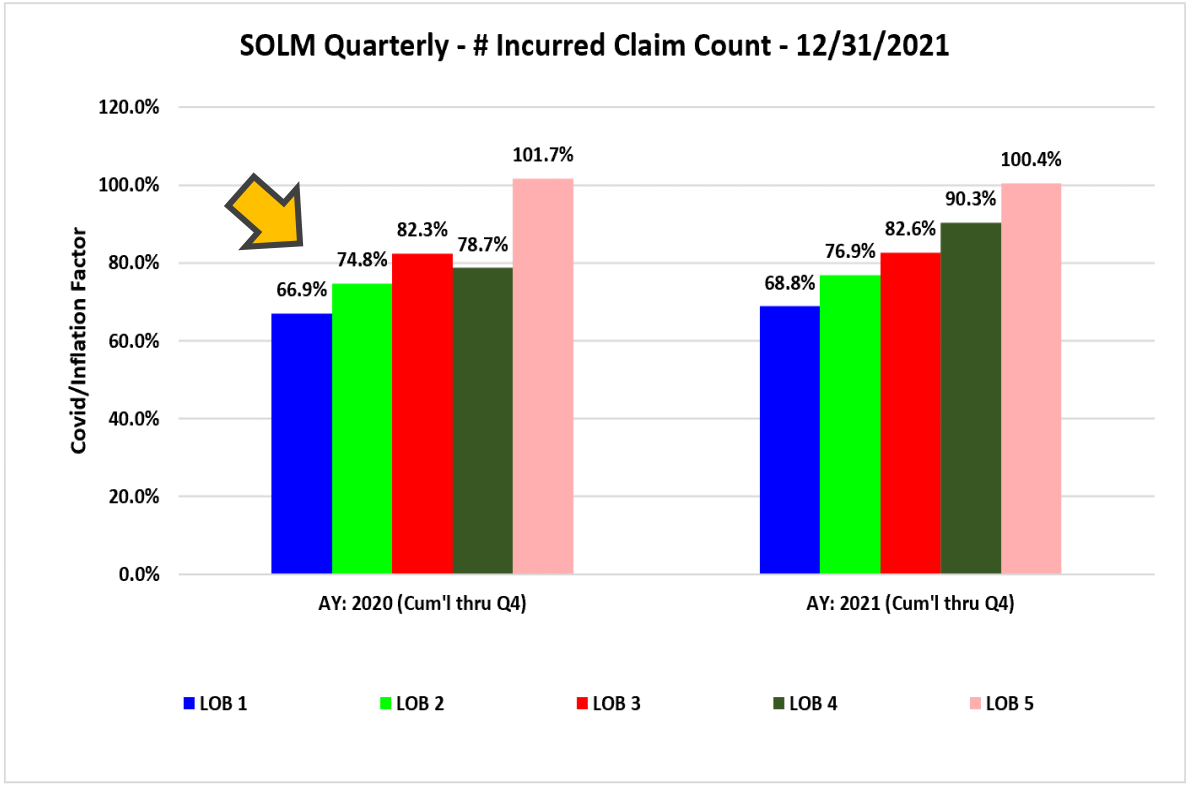
	Claim Count	Severity	Premium
2020	0.831	1.098	0.985
2021	0.806	1.181	1.006
2022	?	?	?

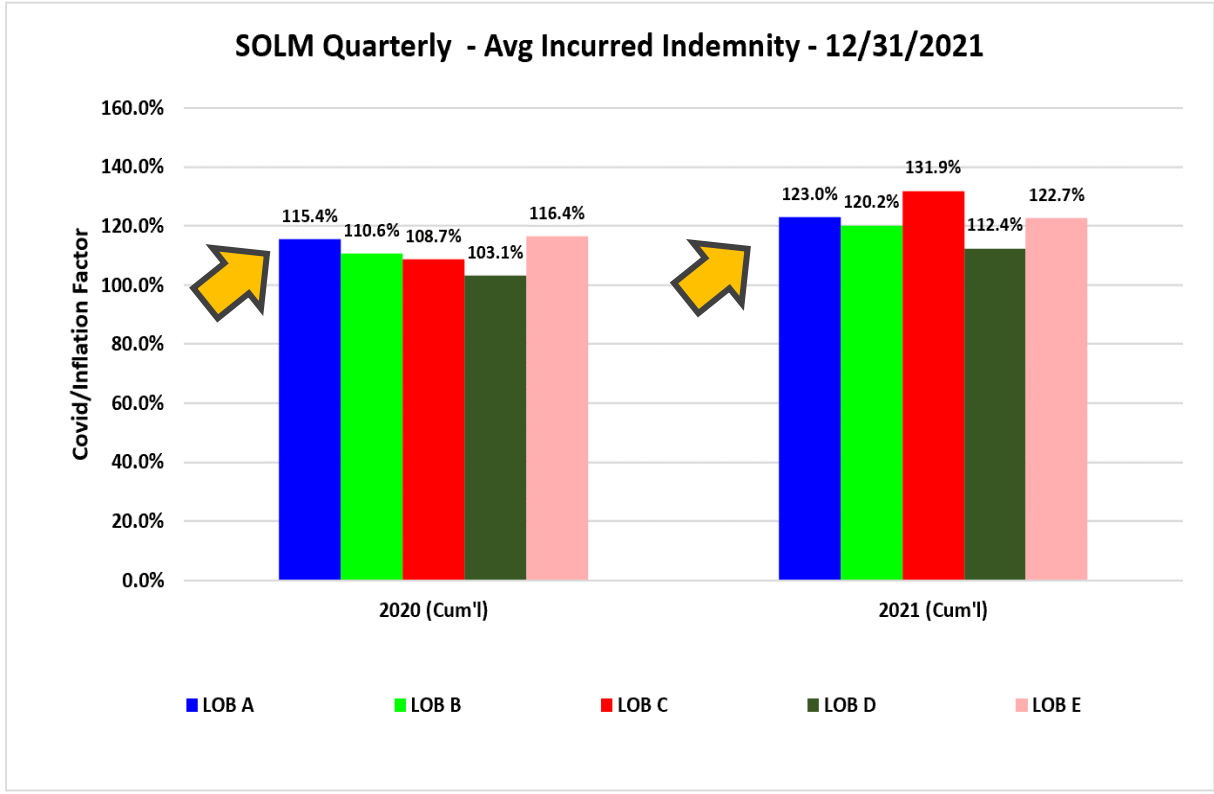
# of Claims (5 years) 73,945

NB: mechanical selection for LDFs of last 7 qtr VWA used in projections from GL SOLM-Qtr at 12/31/2021. No tail beyond 2017 supplied.

Impact of Covid/Heightened Inflation on 2020-2021 Cross Line Comparison - Frequency and Severities

Verisk™ Illustrative





Note: Values shown may not match selections shown

GL Sample Triangle – Pre vs. Post Covid

Verisk™
Illustrative

Subline	PremOps
Class Group	Entertainment and Recreation | Hotels and Motels | Restaurants and Bars | Schools
Region	Countrywide
Cause of Loss	All Causes of Loss
Claim Size	1 - <10k | 10k - <25k | >= 25k
Company Speed	Slower

This exhibit shows a sample cumulative quarterly triangle for Incurred Indemnity. The large drop off in indemnity starting in 2020Q2 can be clearly seen with a gradual bounce back in quarters since.

Looking at development factors, we can see that these factors have increased in the Covid quarters from what we have seen in the past showing a lengthening pattern. Due to this change in factors, it is important to select the proper pattern for development as the calculation of ultimates can change significantly based on these assumptions.

Incurred Indemnity

Loss Year	Loss Month	3	6	9	12	15	18	21	24	27
2017	3	12,986,765	24,585,150	28,025,667	31,522,452	33,375,628	36,542,795	39,812,419	41,377,044	42,881,917
2017	6	13,379,979	26,442,338	31,621,484	34,344,058	36,754,622	37,705,510	40,324,617	42,159,622	46,348,010
2017	9	12,755,620	23,707,952	28,958,385	32,708,063	35,610,202	39,113,093	43,203,739	46,990,559	49,826,984
2017	12	10,995,879	22,295,441	26,041,934	31,209,357	34,412,694	36,358,716	39,371,370	42,923,200	46,468,535
2018	3	14,305,945	23,842,980	26,477,180	30,312,888	33,581,617	35,294,478	39,353,856	39,833,878	41,311,357
2018	6	14,124,973	22,747,567	25,920,620	27,125,996	29,899,525	32,865,568	35,885,880	36,995,077	39,352,043
2018	9	15,085,205	26,564,290	32,459,853	34,049,244	38,179,258	40,857,234	43,662,596	46,377,747	49,546,428
2018	12	13,832,055	22,781,539	26,187,857	28,927,808	30,163,114	34,406,407	37,906,840	41,069,395	42,425,294
2019	3	14,635,263	24,641,084	28,343,451	31,295,762	35,175,836	40,060,953	42,850,286	47,405,417	48,075,583
2019	6	15,062,756	25,736,269	31,910,835	34,825,105	40,820,736	43,188,128	46,497,140	48,403,053	49,297,703
2019	9	13,425,461	24,672,926	28,602,372	34,065,357	36,602,993	40,383,078	44,912,278	47,135,400	52,942,202
2019	12	14,285,965	24,477,721	29,931,993	31,761,105	34,584,569	39,552,936	41,928,174	43,130,436	47,429,957
2020	3	13,276,295	23,475,238	25,779,045	28,734,885	31,701,357	34,519,618	37,623,945	41,178,269	
2020	6	3,607,552	8,650,967	10,106,916	11,540,029	11,993,917	14,144,926	16,037,001		
2020	9	8,827,758	17,306,620	19,063,778	21,229,860	22,988,850	25,137,358			
2020	12	8,467,011	13,097,636	15,381,172	16,755,359	19,151,523				
2021	3	9,000,827	22,436,424	25,761,010	29,439,533					
2021	6	9,676,074	20,225,863	25,100,772						
2021	9	10,487,807	21,715,737							
2021	12	8,644,690								

		6/3	9/6	12/9	15/12	18/15	21/18	24/21	27/24	30/27
2017	3	1.893	1.140	1.125	1.059	1.095	1.089	1.039	1.036	1.062
2017	6	1.976	1.196	1.086	1.070	1.026	1.069	1.046	1.099	1.057
2017	9	1.859	1.221	1.129	1.089	1.098	1.105	1.088	1.060	1.027
2017	12	2.028	1.168	1.198	1.103	1.057	1.083	1.090	1.083	0.981
2018	3	1.667	1.110	1.145	1.108	1.051	1.115	1.012	1.037	1.124
2018	6	1.610	1.139	1.047	1.102	1.099	1.092	1.031	1.064	1.090
2018	9	1.761	1.222	1.049	1.121	1.070	1.069	1.062	1.068	1.067
2018	12	1.647	1.150	1.105	1.043	1.141	1.102	1.083	1.033	1.035
2019	3	1.684	1.150	1.104	1.124	1.139	1.070	1.106	1.014	1.089
2019	6	1.709	1.240	1.091	1.172	1.058	1.077	1.041	1.018	1.146
2019	9	1.838	1.159	1.191	1.074	1.103	1.112	1.049	1.123	1.058
2019	12	1.713	1.223	1.061	1.089	1.144	1.060	1.029	1.100	
2020	3	1.768	1.098	1.115	1.103	1.089	1.090	1.094		
2020	6	2.398	1.168	1.142	1.039	1.179	1.134			
2020	9	1.960	1.102	1.114	1.083	1.093				
2020	12	1.547	1.174	1.089	1.143					
2021	3	2.493	1.148	1.143						
2021	6	2.090	1.241							
2021	9	2.071								

			3 - 6	6 - 9	9 - 12	12 - 15	15 - 18	18 - 21	21 - 24	24 - 27	27 - 30
0	ATA	2017-2019	1.782	1.177	1.111	1.096	1.090	1.087	1.056	1.061	1.067
0	ATA	2020-2021	2.047	1.155	1.120	1.092	1.121	1.112	1.094		
1	ATA	Last 7 Quarters	2.047	1.165	1.122	1.101	1.115	1.092	1.067	1.060	1.087
	ATU		5.996	2.930	2.515	2.241	2.036	1.826	1.672	1.568	1.479
	Ultimate		51,833,604	63,617,122	63,124,160	65,982,506	39,001,725	45,908,938	26,821,601	64,575,205	70,163,691
			1,227,360,324								

NB: mechanical selection for LDFs of last 7 qtr VWA used in projections from GL SOLM-Qtr at 12/31/2021. No tail beyond 2017 supplied.

Measuring Confidence – Covid/Inflation Trends (TBA)

Metrics for Pre Covid, 1st Covid and 2nd Covid year	90% CI		Actual
	Lower	Upper	
Total GL Frequency Change – 2015-2019			
Total GL Frequency Change – 2019-2020			
Total GL Frequency Change – 2020-2021			
Total GL Severity Change – 2015-2019			
Total GL Severity Change – 2019-2020			
Total GL Severity Change – 2020-2021			
Total CAu Frequency Change – 2019-2020			
Total CAu Severity Change – 2020-2021			
Total PAu Frequency Change – 2019-2020			
Total PAu Severity Change – 2020-2021			

Actual Results will be updated with final Qs asked. May swap out lines and may include eg UK Q(s) for 9 and/or 10.

Questions and Feedback

Ask Questions:

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Virtual Conference
June 13–14, 2022
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Seminar on
Reinsurance