Adjusting for 'Limits Drift' in Experience Rating

Revisiting Bob Giambo's 2004 Reinsurance Seminar Presentation

Adam Carvalho, Eric Dynda | CAS Reinsurance Seminar | June 13, 2022

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Meet the Speakers

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Eric Dynda is Vice President at Gallagher Re. He has been with Gallagher Re (formerly Willis Re) since 2017 as a member of the New York actuarial team. He is a Fellow of the Casualty Actuarial Society. At Gallagher Re, he is focused on Casualty treaty reinsurance pricing and modeling for global and US insurance clients.

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Poll time

You are asked to price an Excess of Loss reinsurance contract for a portfolio where the underlying written policy limits have shifted substantially over time. *How would you approach the experience rating for this pricing exercise?*

A. Ignore experience; rely on exposure rating only
B. Use standard experience rating, but adjust selection of credibility weight vs. exposure
C. Capping procedure/other experience adjustment
D. Limit drift adjustment

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Agenda

- Background/Review: Experience rating basics
- The problem: Limits changing over time
- Common approaches to address it
- Limit Drift Adjustment: How to calculate/apply it
- Case Studies
- Common Questions

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Experience Rating: The Basics

- Goal/theory of experience rating: **for a given reinsurance layer, take historical premium and loss data and "transform" it to current conditions in order to estimate go-forward expected loss**
- How do we accomplish goal above? Actuarial techniques that are widely adopted today in transforming data to current level:
  - Loss Trend
  - Loss Development
  - Overcoming the "overlap fallacy" to prove that both trend and development are needed
  - On-levelling premium for filed rates and XS/Umbrella rates

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Experience Rating: The Basics (Example)

- Standard experience rating procedure for Casualty Excess of Loss (XOL) treaties:
  - Trend individual claims from ground-up;
  - Cap at historical policy limit;
  - Slot into reinsurance layer
  - Calculate experience rate as trended/capped layer loss divided by sum of on-level historical premium

SB Ratio 2011-2019	30.1%
SB Ratio 2015-2019	23.7%

20x5 Layer Experience Pricing

Policy Year	Written Premium	Onlevel Written Premium	Layer Losses	Trended Layer Losses	Loss Development Factor	Chain Ladder Trended Ultimate	SB Ultimate Trended Loss & ALAE	SB Ultimate Trended Loss & ALAE Cost
2011	300,000	521,609	0	0	1.055	0	6,443	**1.2%**
2012	315,000	531,738	91,011	261,068	1.113	290,523	273,862	**51.5%**
2013	330,750	542,063	0	58,580	1.152	67,506	75,590	**13.9%**
2014	347,288	552,588	214,197	382,638	1.168	447,043	401,531	**72.7%**
2015	364,652	563,318	131,391	251,587	1.244	313,071	277,842	**49.3%**
2016	382,884	574,256	0	27,475	1.335	36,670	61,649	**10.7%**
2017	402,029	585,407	0	0	1.440	0	42,464	**7.3%**
2018	422,130	602,625	26,286	46,058	1.681	77,416	103,986	**17.3%**
2019	506,556	702,087	104,203	145,737	2.089	304,410	232,586	**33.1%**
2020	607,867	802,385	0	0	3.059	0	128,162	**16.0%**
2021	729,441	875,329	29,341	37,918	9.515	360,797	223,818	**25.6%**

SB stands for the Stanard-Buhlmann Method, a.k.a. "Cape Cod" Method

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The Problem: Shifting limits over time

- **When a ceding company portfolio's limits distribution has shifted significantly over time, traditional experience rating indications for XOL layers will become distorted**
- This occurs whether limits have shifted downwards or upwards
- Distortions persist even if historical premiums are on-levelled and individual claims are trended to future levels
- Illustrations to follow

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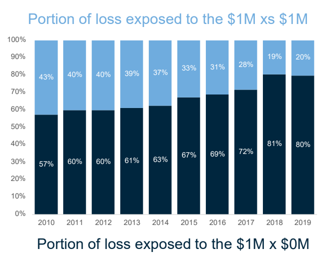
Distortion Scenario #1: Limits drifting downwards



- Assume you are pricing a 1M x 1M XOL layer for a portfolio of policies with a mixture of limits at $1M and $2M
- Ceding company has been reducing the proportion of $2M limit policies in the portfolio consistently over time and is now half of what it was
- $1M x $1M experience from historical years will overstate the amount of loss potential to the layer from the current portfolio if some adjustment is not made

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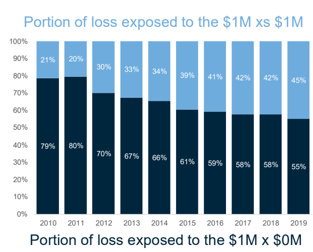
Distortion Scenario #2: Limits drifting upwards



- Assume you are pricing a 1M x 1M XOL layer for a portfolio of policies with a mixture of limits at $1M and $2M
- Ceding company has been increasing the proportion of $2M limit policies in the portfolio consistently over time and is now double what it was
- $1M x $1M experience from historical years will understate the amount of loss potential to the layer from the current portfolio if some adjustment is not made

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Possible Solutions

- **This problem exposes a gap in our current experience rating toolkit for transforming data to current level: adjusting for shifts in policy limits**
- Common approaches to this problem:
  - Incorporate into credibility selection for experience vs. exposure
  - Changing cap when trending losses to adjust for new limits
- Proposed ideal solution: Limit drift adjustment

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Common Approach #1: Credibility adjustment

Method:

Because the going-forward layer experience is likely to be different from the historical experience, a straightforward approach to account for the shift in limits is to reduce the credibility assigned to experience rating when selecting a loss cost for the layer

For a book with steady limits over time, actuary may give 50% credibility to experience

Layer	Exposure Loss Cost	Experience Loss Cost	Credibility to Experience	Selected Loss Cost
5M xs 5M	12.5%	7.5%	50.0%	**10.0%**

If a significant portion of limits are shifting higher, actuary may decide to only give 25% credibility to experience

Layer	Exposure Loss Cost	Experience Loss Cost	Credibility to Experience	Selected Loss Cost
5M xs 5M	12.5%	7.5%	25.0%	**11.3%**

Limitations:

- This is a judgmental approach, and it is very difficult to quantify to what extent the experience credibility should be adjusted
- Our goal as a profession is to shift away from "judgement" approaches and move towards "quantifiable" approaches

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Common Approach #2: Capping adjustment

Method:

- Rather than capping trended losses at the historical policy limit when experience rating, **actuary can use a modified cap that reflects the change in portfolio limits written**
  - Ex: Ceding company used to write $10M limits but has since modified their portfolio to a maximum $5M limit for any policy: actuary can use $5M cap for all historical trended claims

Limitations:

- Theoretically this method could also work in opposite direction: if ceding company has increased limits, actuary can use a higher cap when trending historical claims
  - HOWEVER, the historical incurred claims data is likely to be censored at the lower historical policy limits, which would cause under-trending
- Capping method works well when the shift in the portfolio is "clean" and "complete" such as above example, but usefulness/accuracy is limited when shift is only partial
  - Ex: if ceding company only shifted half of their policies to $5M limit but the other half remain at $10M limit, it is not appropriate to cap all historical claims at $5M
- Another limitation: doesn't account for changing attachment points on XS/Umbrella policies

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Proposed Approach: Limit Drift Adjustment

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- Limit drift adjustment applies a simple, straightforward, quantifiable adjustment factor to historical layer experience that accounts for shifting layer exposure of a portfolio over time
- Limit drift adjustment is a versatile methodology in that it can:
  - account for limits going in either direction (up or down)
  - accurately account for partial shifts in the limit distribution of the underlying portfolio over time
  - automatically account for attachment point changes
- Necessary data (beyond what is required for standard experience rating):
  - In-force policy limit profile evaluated as-of each historical year being analyzed
  - Exposure ILF curve

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History of the limit drift adjustment

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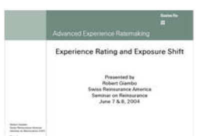
- This problem/challenge of shifting limits and their impact on experience rating, along with the proposed solution of limits drift adjustment, has already been introduced by Robert Giambo at the 2004 CAS Reinsurance Seminar
- Despite Giambo's presentation, the method has so far not achieved widespread adoption or dissemination through the CAS syllabus/practitioner toolkit
- Goal of this presentation is to re-focus attention and revive discussion around the limit drift adjustment method



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Limit Drift Factor: How to Calculate

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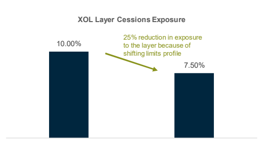
- Obtain cessions exposure for the XOL layer of interest for each individual historical year's limits profile **using today's exposure curve**
- Difference in cessions exposure rate between today's limits profile vs. historical limits profile can be translated directly into limits drift factor to be applied to the old year
- Example: Limit drift factor for an old year in a portfolio where limits have been shifting downward over time
  - Cessions exposure (year t): 7.5%
  - Cessions exposure (year t-3): 10.0%
  - Limit drift factor (year t-3): 7.5% / 10.0% = **0.75**

Year t-3 experience rate is adjusted by 0.75 to account for the fact that there is 25% less exposure to the layer in the limits profile today vs. three years ago when experience occurred



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Portfolio Example

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Case Study #1

A reduction in limits

- A company, Apprehensive Mutual, writes high excess business and has decided to take a targeted approach at reducing limits on their book.
- In policy years 2018 and prior they wrote a mix of $5M – $25M limits but decided in 2019 to start reducing limits decided going forward that they are going to concentrate on writing limits of $15M and below.
- They have historically bought excess of loss coverage for the excess of $5M layer, a $20M xs $5M
- We have been asked to price that layer for 2022.

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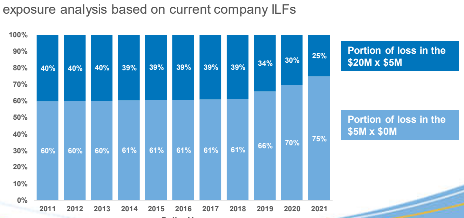
Case Study #1

Approach to Experience Rating

- To make the adjustment to experience for this limit drift downwards we will need:
  - Historical policy listing for the experience period
  - Latest policy listing
  - Current ILFs or exposure curve
- Run an exposure analysis based on current company ILFs



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Case Study #1

Calculating Loss Exposed to each layer

- To make the adjustment to experience for this limit drift downwards we will need:
  - Historical policy listing for the experience period
  - Latest policy listing
  - Current ILFs or exposure curve
- Run an exposure analysis based on current company ILFs

Policy Year	Written Premium	$20M xs $5M Layer Cessions	Portion of loss in $5M x $0M	Portion of loss in $20M x $5M
2011	300	120	60%	40%
2012	315	125	60%	40%
2013	331	131	60%	40%
2014	347	137	61%	39%
2015	365	143	61%	39%
2016	383	149	61%	39%
2017	402	156	61%	39%
2018	422	163	61%	39%
2019	507	172	66%	34%
2020	608	182	70%	30%
2021	729	182	75%	25%

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Case Study #1

Calculating Limit Drift Factor

Policy Year	Portion of Loss in $5M x $0M	Portion of Loss in $20M x $5M	Index Level of Relative Losses in $5M xs $0M	Index Level of Relative Losses in $20M xs $5M	Limit Drift Factor
2011	60%	40%	100%	100%	0.625
2012	60%	40%	100%	100%	0.628
2013	60%	40%	101%	99%	0.631
2014	61%	39%	101%	99%	0.634
2015	61%	39%	101%	98%	0.638
2016	61%	39%	102%	98%	0.641
2017	61%	39%	102%	97%	0.644
2018	61%	39%	102%	97%	0.647
2019	66%	34%	110%	85%	0.735
2020	70%	30%	117%	75%	0.833
2021	75%	25%	125%	63%	1.000

Calculate the relativity to prior levels of loss in the layer; then build a relatively on the latest loss level

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Case Study #1

Adjusting Experience

20x5 Layer Experience

Policy Year	Onlevel Written Premium	Layer Losses	Trended Layer Losses	Limit Drift Factor	Adj Trended Loss & ALAE
2011	521,609	0	0	0.625	0
2012	531,738	91,011	261,068	0.628	163,988
2013	542,063	0	58,580	0.631	36,981
2014	552,588	214,197	382,638	0.634	242,772
2015	563,318	131,391	251,587	0.638	160,427
2016	574,256	0	27,475	0.641	17,608
2017	585,407	0	0	0.644	0
2018	602,625	26,286	46,058	0.647	29,814
2019	702,087	104,203	145,737	0.735	107,159
2020	802,385	0	0	0.833	0
2021	875,329	29,341	37,918	1.000	37,918
Total	6,853,403	596,428	1,211,062		796,668

- Taken from example above, limit drift factor applied to trended layer losses to adjust historical losses to the current level

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Case Study #1

Calculating Adjusted Loss Cost

SB Ratio 2011-2019	19.5%
SB Ratio 2015-2019	15.9%

20x5 Layer Experience Pricing

Policy Year	Written Premium	Onlevel Written Premium	Adj Trended Loss & ALAE	Loss Development Factor	Chain Ladder Trended Ultimate	SB Ultimate Trended Loss & ALAE	SB Ultimate Trended Loss & ALAE Cost
2011	300,000	521,609	0	1.055	0	4,310	**0.8%**
2012	315,000	531,738	163,988	1.113	182,490	172,547	**32.4%**
2013	330,750	542,063	36,981	1.152	42,617	48,361	**8.9%**
2014	347,288	552,588	242,772	1.168	283,635	255,412	**46.2%**
2015	364,652	563,318	160,427	1.244	199,632	177,991	**31.6%**
2016	382,884	574,256	17,608	1.335	23,501	40,470	**7.0%**
2017	402,029	585,407	0	1.440	0	28,409	**4.9%**
2018	422,130	602,625	29,814	1.681	50,113	68,569	**11.4%**
2019	506,556	702,087	107,159	2.089	223,831	165,262	**23.5%**
2020	607,867	802,385	0	3.059	0	85,742	**10.7%**
2021	729,441	875,329	37,918	9.515	360,797	162,287	**18.5%**

	Before	After	% Change
SB Ratio 2011-2019	30.1%	19.5%	-54.6%
SB Ratio 2015-2019	23.7%	15.9%	-49.5%

SB stands for the Stanard-Buhlmann Method, a.k.a. "Cape Cod" Method

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Case Study #2

- A company, Risky Mutual, writes high excess business and has decided to take a targeted approach at expanding limits on their book.
- In policy years 2017 and prior they wrote a mix of $10M – $15M limits but decided in 2018 to start expanding limits going forward. They will start to write limits of $15M - $25M.
- They have historically bought excess of loss coverage for the $10M xs $5M layer. With the expansion of limits in the excess of $5M layer, the company is looking to purchase a $20M xs $5M coverage
- We have been asked to price that layer for 2022.

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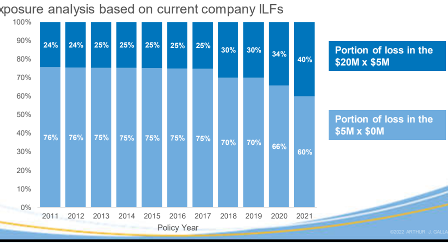
Case Study #2

Approach to Experience Rating

- To make the adjustment to experience for this limit drift upwards we will need:
  - Historical policy listing for the experience period
  - Latest policy listing
  - Current ILFs or exposure curve
- Run an exposure analysis based on current company ILFs



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Case Study #2

Calculating Loss Exposed to each layer

- To make the adjustment to experience for this limit drift upwards we will need:
  - Historical policy listing for the experience period
  - Latest policy listing
  - Current ILFs or exposure curve
- Run an exposure analysis based on current company ILFs

Policy Year	Written Premium	$20M xs $5M Layer Cessions	Portion of loss in $5M x $0M	Portion of loss in $20M x $5M
2011	300	73	76%	24%
2012	315	77	76%	24%
2013	331	81	75%	25%
2014	347	86	75%	25%
2015	365	90	75%	25%
2016	383	95	75%	25%
2017	402	101	75%	25%
2018	422	127	70%	30%
2019	507	152	70%	30%
2020	608	207	66%	34%
2021	729	292	60%	40%

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Case Study #2

Calculating Limit Drift Factor

Policy Year	Portion of loss in $5M x $0M	Portion of loss in $20M x $5M	Index Level of Relative Losses in $5M xs $0M	Index Level of Relative Losses in $20M xs $5M	Limit Drift Factor
2011	76%	24%	100%	100%	1.649
2012	76%	24%	100%	101%	1.641
2013	75%	25%	100%	101%	1.632
2014	75%	25%	100%	102%	1.624
2015	75%	25%	99%	102%	1.616
2016	75%	25%	99%	103%	1.608
2017	75%	25%	99%	103%	1.600
2018	70%	30%	92%	124%	1.333
2019	70%	30%	92%	124%	1.333
2020	66%	34%	87%	140%	1.176
2021	60%	40%	79%	165%	1.000

Calculate the relativity to prior levels of loss in the layer; then build a relatively on the latest loss level

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Case Study #2

Adjusting Experience

20x5 Layer Experience Pricing

Policy Year	Onlevel Written Premium	Layer Losses	Trended Layer Losses	Limit Drift Factor	Adj Trended Loss & ALAE
2011	521,609	0	0	1.649	0
2012	531,738	91,011	261,068	1.641	428,311
2013	542,063	0	58,580	1.632	95,626
2014	552,588	214,197	382,638	1.624	621,497
2015	563,318	131,391	251,587	1.616	406,595
2016	574,256	0	27,475	1.608	44,181
2017	585,407	0	0	1.600	0
2018	602,625	26,286	46,058	1.333	61,411
2019	702,087	104,203	145,737	1.333	194,316
2020	802,385	0	0	1.176	0
2021	875,329	29,341	37,918	1.000	37,918

- Taken from example above, limit drift factor applied to trended layer losses to adjust historical losses to the current level

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Case Study #2

Calculating Adjusted Loss Cost

SB Ratio 2011-2019	47.5%
SB Ratio 2015-2019	35.6%

20x5 Layer Experience Pricing

Policy Year	Onlevel Written Premium	Adj Trended Loss & ALAE	Loss Development Factor	Chain Ladder Trended Ultimate	SB Ultimate Trended Loss & ALAE	SB Ultimate Trended Loss & ALAE Cost
2011	521,609	0	1.055	0	9,667	**1.9%**
2012	531,738	428,311	1.113	476,635	447,507	**84.2%**
2013	542,063	95,626	1.152	110,198	121,149	**22.3%**
2014	552,588	621,497	1.168	726,106	649,846	**117.6%**
2015	563,318	406,595	1.244	505,961	445,989	**79.2%**
2016	574,256	44,181	1.335	58,967	95,457	**16.6%**
2017	585,407	0	1.440	0	63,715	**10.9%**
2018	602,625	61,411	1.681	103,221	148,330	**24.6%**
2019	702,087	194,316	2.089	405,880	324,630	**46.2%**
2020	802,385	0	3.059	0	192,302	**24.0%**
2021	875,329	37,918	9.515	360,797	316,854	**36.2%**

	Before	After	% Change
SB Ratio 2011-2019	30.1%	47.5%	36.7%
SB Ratio 2015-2019	23.7%	35.6%	33.4%

SB stands for the Stanard-Buhlmann Method, a.k.a. "Cape Cod" Method

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Case Study #2

Observations

- Using limit drift is the best way to approximate losses into higher layers that have not been historically written as much, but still has the propensity to underestimate if policies were not written at these levels historically.

Example:

- There have historically been policies written at $5M, so the most loss you will have from a given policy is $5M.
- If the company starts to write $10M policies, the capped historical losses will not be informative for the $5M xs $5M layer

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Common Questions

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Question #1: Does on-leveling premium overlap with limit drift?

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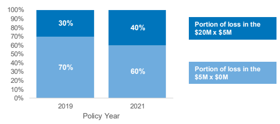
- **On-level factors:** adjust for market cycle dynamics and price adequacy of portfolio
- **Limit drift factors:** adjust for changes in reinsurance layer exposure of portfolio due to changes in structures (policy limit/attachment point)

On-level factors change the size of the total base from ground up

Limit drift factors do not change the size of the total base; they instead account for the re-apportionment of losses between retention layer and reinsurance layer



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On-level vs. Limit Drift examples

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Example #1:
Rate change: 10%
Policy Limit: Unchanged

Example #1: Rate Growth Only

	2021		2022
Written Premium	100	→	110
XOL Layer Cessions %	20.0%	→	20.0%
XOL Layer Cessions $	20	→	22

On-level factor for 2021:	Rate level$_{2022}$ / Rate level$_{2021}$	**1.10**
Limit drift factor for 2021:	Cessions% $_{2022}$ / Cessions%$_{2021}$	**1.00**

Example #2:
Rate change: None
Policy Limit: Reduced

Example #2: Reduced Limits Only

	2021		2022
Written Premium	100	→	85
XOL Layer Cessions %	20.0%	→	10.0%
XOL Layer Cessions $	20	→	8.5

On-level factor for 2021:	Rate level$_{2022}$ / Rate level$_{2021}$	**1.00**
Limit drift factor for 2021:	Cessions% $_{2022}$ / Cessions%$_{2021}$	**0.50**

Example #3:
Rate change: 10%
Policy Limit: Reduced

Example #3: Rate Growth AND Reduced Limits

	2021		2022
Written Premium	100	→	93.5
XOL Layer Cessions %	20.0%	→	10.0%
XOL Layer Cessions $	20	→	9.35

On-level factor for 2021:	Rate level$_{2022}$ / Rate level$_{2021}$	**1.10**
Limit drift factor for 2021:	Cessions% $_{2022}$ / Cessions%$_{2021}$	**0.50**

Example #2 and #3 have the same limit drift factor: factor values are unaffected by changes in the other variable

Key assumptions: rate change is consistent across portfolio; loss ratio is the same across limits; using same ILF curve to calculate cessions for both years

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Question #2: Why not use Exposure Rating alone in these cases?

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- Experience rating still has value and can provide additional insight that exposure rating cannot
- Limit-drift adjusted experience analysis can tell you whether company has had more-than or less-than expected level of loss activity to the given layer, just like a standard experience analysis on a steady-limits portfolio would tell you
- Limit drift adjustment makes experience rating meaningful again for books where exposure has shifted dramatically over time

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Question #3: What if there are problems with my historical limit profiles?

Potential problem #1: Practitioner may encounter a situation where they want to incorporate a limit drift adjustment to an experience analysis, but limits profiles for each historical year are not available to calculate limit drift factors

Potential solution: Approximate shift in limits over time based on knowledge of portfolio or industry shift

Potential problem #2: Practitioner may have historical limits profiles on a different time basis than experience years

Potential solution: Interpolation between profiles as appropriate

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Wrap Up

- Limit drift should be utilized to adjust experience when limits in a portfolio have been changing over time
- Limit drift is superior to other methods of adjusting experience because it's quantifiable and versatile
- Should be considered and implemented when limits have been changing to get a more accurate experience assumption

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Further Information

For further Information on Limit drift, including workbooks to implement limit drift within your own analysis please feel free to reach out to either of us

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Thank you!

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Appendix

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At what point of analysis should limit drift factor be applied?

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- Option #1: Apply limit drift factor to trended layer loss directly (before developing to ultimate)
- Option #2: Apply limit drift factor to final ultimate losses/loss cost (after developing to ultimate)
- These methods are equivalent under chain ladder technique, but will produce somewhat different results under BF/SB method
- Applying to trended losses directly will include adjustment in a-priori selection, which is desirable, but will not work ideally in situations where you have years starting with zero trended layer loss

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