Boot Camp on Reinsurance Pricing Techniques

Loss Sensitive Treaty Features

Patty Kinghorn, ACAS, MAAA

AUGUST 2019

General Concepts Discussed

- Defining loss sensitive features
- How to use loss sensitive features
- Examples of loss sensitive features
- Valuing loss sensitive features in a treaty
- Other Considerations
- Estimating Aggregate Distributions
- Questions

What is a Loss Sensitive Feature?

- Is a provision within a reinsurance contract that causes the ceded premium, ceded loss or commission to vary based on the loss experience of the contract

- Premiums or commissions start at “provisional” level and are indexed up or down in response to loss activity

- Loss terms involves sharing of losses among the parties to the contract impacting the final cost to the cedant

Why include loss sensitive terms?

- Treaty pricing – can make everyone in the process unhappy
- Reinsurers loss picks may appear high to ceding insurers
  - ✓ Reinsurers pricing conservative due to lack of information
  - ✓ Insurer is confident about underwriting expertise
- Benefits of loss sensitive feature:
  - ✓ Allows cedants to share in the ceded experience – motivation to improve results
  - ✓ Bridge the gap between reinsurer's loss pick and cedant's loss pick
  - ✓ Adjust initial premium/commissions retrospectively
  - ✓ Limit exposure in exchange for rate concession
- Reinsurance pricing actuary's role is to figure out the value of the feature:
  - ✓ How does the loss sensitive feature impact the underwriting ratio?
  - ✓ Does the loss sensitive feature make sense along with the rest of the deal structure?
  - ✓ Can present various structure options that gives cedant and reinsurer same value

Types of Loss Sensitive Features

- Features that cause **ceded premium** to vary based on loss experience:
  - ✓ Reinstatement provisions, or additional premiums
  - ✓ Swing rated contracts
  - ✓ No claims bonus

- Features that cause **ceding commission** to vary based on loss experience:
  - ✓ Profit commission
  - ✓ Sliding scale commission

- Features that cause **ceded loss** to vary based on loss experience:
  - ✓ Annual aggregate deductibles (AADs)
  - ✓ Loss ratio corridors
  - ✓ Loss ratio caps

Which reinsurance structures have these features?

- Pro Rata / QS treaties
  - ✓ Profit commission
  - ✓ Sliding scale commission
  - ✓ Loss corridor (%, $)
  - ✓ Aggregate cap (%, $)
- Excess of Loss (XOL) treaties:
  - ✓ Profit commission
  - ✓ Reinstatements
  - ✓ Swing rating provisions
  - ✓ No claims bonuses (typically catastrophe XOLs)
  - ✓ Annual aggregate deductibles
  - ✓ Annual aggregate limits ($)
  - ✓ Loss ratio cap (%)

Profit Commission (PC)

- Used in quota share or XOL to reward good results, helps settle pricing disputes
- Cedant can receive a defined percentage of “profit” on the reinsurance contract
- Profit is often defined as Premium – Loss – Commission – Reinsurer’s Margin
- Profit = Premium – loss – commission – margin
- Margin is a provision for reinsurer expenses
- Example:
  - ✓ Profit commission is 50% after 10% reinsurer’s margin
  - ✓ Ceding commission of 30%
  - ✓ Profit % = (1 – 30% CC – 10% RM – loss ratio %) = 60% – loss ratio %
  - ✓ PC = 50% x maximum (0%, 60% - loss ratio %)
  - ✓ Cedant will receive some sort of profit commission for loss ratio result that is lower than 60%

Profit Commission (PC) – (continued)

- What is the EXPECTED cost of the PC?
- If ELR is 60% - does this mean expected cost of PC is zero?
- Although no PC is paid at ELR, that seldom means the EXPECTED cost of the PC is zero
- The cost of the PC at the EXPECTED loss ratio is not equal to the EXPECTED of the PC
- Why?
  - ✓ 60% is the EXECTED loss ratio – there are other loss ratio outcomes for this treaty
  - ✓ There is a probability distribution of potential outcomes around the 60% EXPECTED loss ratio
  - ✓ Therefore it is possible that the loss ratio in any year could be less than 60% (i.e. PC is paid)
  - ✓ There is a COST to this feature, discussed soon
- Advice: Use illustrations, pictures and animations to help you communicate to underwriters

Cost of Profit Commission – Specific Example

- Note a PC only goes one way – cedant receives money when deal is running profitably. The cedant does not pay more when the deal isn't running profitably
- Earthquake exposed California property QS
  - ✓ Non-Cat ELR = 40% (certain)
  - ✓ Cat (EQ) ELR = 30%, based on at most 1 EQ per year
    - Pr(EQ) = 10% where resulting loss ratio is 300%
    - Pr (no EQ) = 90%
  - ✓ Ceding commission = 30%
  - ✓ PC is 50% after 10% reinsurer margin, net of 30% CC
- PC Scenarios where PC =50% x (1 – cat LR – non-cat LR – ceding commission – margin)= 50% x (1 – cat LR – 40% - 30% - 10%) = 50% (20% - cat LR)
  - ✓ If no EQ then PC = 10%
  - ✓ If EQ then PC = 0%
- Expected cost of PC = Pr (no EQ) x 10% + Pr (EQ) x 0% = 90% x 10% = 9% of ceded premium

Cost of Profit Commission – General Approach

- Build aggregate loss distribution
  - ✓ Select loss ratio outcomes (scenario testing) and assign each a probability of happening
  - ✓ Fit data to an aggregate distribution (e.g. Lognormal) or fit frequency data and severity data separately and combine
  - ✓ Curve fitting – beyond the scope of this presentation
- Apply loss sensitive terms to each point on the loss distribution or to each simulated year
- Calculate a probability weighted cost (benefit) of the loss sensitive features in the contract

Cost of Profit Commission – Example

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Scenario	Probability	Loss Ratio	Ceding Commission	Reinsurer Margin	Cost of PC at Loss Ratio	Underwriting Ratio
1	4.0%	25.0%	30.0%	10.0%	17.5%	72.5%
2	10.0%	35.0%	30.0%	10.0%	12.5%	77.5%
3	20.0%	40.0%	30.0%	10.0%	10.0%	80.0%
4	25.0%	50.0%	30.0%	10.0%	5.0%	85.0%
5	20.0%	**60.0%**	**30.0%**	**10.0%**	**0.0%**	**90.0%**
6	15.0%	70.0%	30.0%	10.0%	0.0%	100.0%
7	2.0%	80.0%	30.0%	10.0%	0.0%	110.0%
8	2.0%	145.0%	30.0%	10.0%	0.0%	175.0%
9	1.0%	350.0%	30.0%	10.0%	0.0%	380.0%
10	1.0%	450.0%	30.0%	10.0%	0.0%	480.0%
Total	100.0%	**60.0%**	**30.0%**	**10.0%**	**5.2%**	**95.2%**

Notes: (6) =Max {0%,50% x [1 - (3) - (4) - (5)]}
(7) = (3) + (4) + (6)

Conclusion – the Expected PC (5.2%) does not equal the PC Cost at ELR (0%)

Cost of Profit Commission (continued)

- Loss distribution determines the value of loss sensitive feature
  - ✓Distribution assigns probability to each loss ratio value
  - ✓Loss ratio determines PC for scenario or value
- With skewed distributions seen in reinsurance the more apt you are to have to pay cedant for PC
  - ✓Especially true for XOL – you need many better than average scenarios to balance extreme scenarios
  - ✓Favorable scenarios are the ones that trigger the PC
- Loss distribution drives pricing. Be aware – loss sensitive feature cost estimates and overall treaty pricing assumptions must line up – not easy

Cost of Profit Commission – Example #2 – different loss distribution

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Scenario	Probability	Loss Ratio	Ceding Commission	Reinsurer Margin	Cost of PC at Loss Ratio	Underwriting Ratio
1	0.0%	25.0%	30.0%	10.0%	17.5%	72.5%
2	1.0%	35.0%	30.0%	10.0%	12.5%	77.5%
3	15.0%	40.0%	30.0%	10.0%	10.0%	80.0%
4	25.0%	50.0%	30.0%	10.0%	5.0%	85.0%
5	30.0%	**60.0%**	**30.0%**	**10.0%**	**0.0%**	**90.0%**
6	20.0%	70.0%	30.0%	10.0%	0.0%	100.0%
7	6.0%	80.0%	30.0%	10.0%	0.0%	110.0%
8	3.0%	145.0%	30.0%	10.0%	0.0%	175.0%
9	0.0%	350.0%	30.0%	10.0%	0.0%	380.0%
10	0.0%	450.0%	30.0%	10.0%	0.0%	480.0%
Total	100.0%	**60.0%**	**30.0%**	**10.0%**	**2.9%**	**92.9%**

Notes: (6) =Max {0%,50% x [1 - (3) - (4) - (5)]}
(7) = (3) + (4) + (6)

Cost of Profit Commission – Example #3 – another loss distribution

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Scenario	Probability	Loss Ratio	Ceding Commission	Reinsurer Margin	Cost of PC at Loss Ratio	Underwriting Ratio
1	0.0%	25.0%	30.0%	10.0%	17.5%	72.5%
2	0.0%	35.0%	30.0%	10.0%	12.5%	77.5%
3	0.0%	40.0%	30.0%	10.0%	10.0%	80.0%
4	33.3%	50.0%	30.0%	10.0%	5.0%	85.0%
5	33.3%	**60.0%**	**30.0%**	**10.0%**	**0.0%**	**90.0%**
6	33.3%	70.0%	30.0%	10.0%	0.0%	100.0%
7	0.0%	80.0%	30.0%	10.0%	0.0%	110.0%
8	0.0%	145.0%	30.0%	10.0%	0.0%	175.0%
9	0.0%	350.0%	30.0%	10.0%	0.0%	380.0%
10	0.0%	450.0%	30.0%	10.0%	0.0%	480.0%
Total	100.0%	**60.0%**	**30.0%**	**10.0%**	**1.7%**	**91.7%**

Notes: (6) =Max {0%,50% x [1 - (3) - (4) - (5)]}
(7) = (3) + (4) + (6)

Other Loss Sensitive Features on QS's

- Profit Commission (already covered)
- Sliding Scale Commission
- Loss Corridor
- Loss Ratio Cap

Sliding Scale Commission

- Ceding commission is set at a “provisional” level at the beginning of a contract
- It typically corresponds to a certain loss ratio in the contract – 20% cede at 65% LR
- Ceding commission INCREASES if the contract’s loss ratio is lower than the loss ratio that corresponds to the provisional, usually subject to a maximum commission
- Ceding commission DECREASES if the contract’s loss ratio is higher than the loss ratio that corresponds to the provisional, usually subject to a minimum commission
- Thus – the ceding commission “slides” in the opposite direction as the loss ratio
- A slide is useful when reinsurer and insurer’s loss picks differ

Sliding Scale Example

- Provisional ceding commission = 20%, ELR = 60%
- If loss ratio < 65% then the commission will increase by 1 point for each point decrease in the loss ratio. The maximum commission will be 25% (at 60% or lower)
- This is said to slide “1 to 1” and is considered a “steep slide”
- If loss ratio is > 65% the commission will decrease by 0.5 point for each 1 point increase in the loss ratio. The minimum commission will be 15% (at 75% or higher)
- This is said to slide “1/2 to 1”

Is the expected ceding commission = ceding commission at ELR?

	(1)		(2)	(3)	(4)
	Ceding Commission		Loss Ratio	Cede + Loss Ratio	Margin
Minimum	15%	@	75%	90%	10%
Provisional	20%	@	65%	85%	15%
Maximum	25%	@	60%	85%	15%

Notes: (3) = (1) + (2)
(4) = 1 - (3)

Valuing a sliding scale commission

(1)	(2)	(3)	(4)	(5)
Scenario	Probability	Loss Ratio	Ceding Commission	Underwriting Ratio
1	4.0%	25.0%	25.0%	50.0%
2	10.0%	35.0%	25.0%	60.0%
3	20.0%	40.0%	25.0%	65.0%
4	25.0%	50.0%	25.0%	75.0%
5	20.0%	**60.0%**	**25.0%**	**85.0%**
6	15.0%	70.0%	17.5%	87.5%
7	2.0%	80.0%	15.0%	95.0%
8	2.0%	145.0%	15.0%	160.0%
9	1.0%	350.0%	15.0%	365.0%
10	1.0%	450.0%	15.0%	465.0%
Total	100.0%	**60.0%**	**23.3%**	**83.3%**

Notes: "(4) = IF{ (3) < 65% ,MIN[25% , 20% + 65% - (3)],
Else MAX [15% , 20% +0.5*(65% -(3))] }

(5) = (3) + (4)

Loss Ratio Corridor

- Loss ratio corridor is a provision where ceding company retains losses that would otherwise be ceded to the reinsurance treaty
- Useful when there is a difference in the loss ratio pick but not as common as a slide
- For example, the ceding company could keep 100% of the losses between a 75% and 85% loss ratio – or a "10 point corridor attaching at 75%"
  - ✓ If the gross loss ratio = 75% then the ceded loss ratio = 75% (no corridor attaches)
  - ✓ If the gross loss ratio =80% then the ceded loss ratio = 75% - ceding company takes losses between 75% and 80%
  - ✓ If the gross loss ratio =85% then the ceded loss ratio is still 75%
  - ✓ If gross loss ratio = 100% - what is the ceded loss ratio?
- Note – corridor does not have to be 100% retained

Loss Ratio Cap

- This is the maximum loss ratio that could be ceded to the treaty
- Once losses hit or exceed cap – no more can be ceded to the treaty
- Example 200% loss ratio cap
  - ✓ If the loss ratio before the cap is 150% then the ceded loss ratio is 150%
  - ✓ If the loss ratio before the cap is 300% then the ceded loss ratio is 200%
- Useful for new/start up operations where the limit to premium ratio may be imbalanced
  - ✓ Example – new umbrella program offering $10M policy limits but only plans on writing $3M in premium the first year
  - ✓ Perhaps to get treaty placed there is a 300% loss ratio cap (in this case 3 x $3M of premium = $9M) – this may be only way reinsurance treaty is placed – cap is high but deal downside is limited
- May want to speak to our auditor for an opinion on risk transfer

Loss Sensitive Features on XOLs

- Profit Commission (previously discussed)
- Swing rates
- Reinstatements and aggregate limits
- Annual aggregate deductibles
- No claims bonuses (if anywhere, Cat XOLs)
- Loss ratio cap (previously discussed)

Swing Rating Provisions

- Ceded premium is dependent on loss experience
  - ✓ Reinsurer pays initial premium based on a provisional rate
  - ✓ The rate swings up or down depending on the loss experience in accordance to the terms of the treaty
- Example swing rated terms
  - ✓ Provisional rate = 10%
  - ✓ Minimum rate/margin = 3%
  - ✓ Maximum rate = 15%
  - ✓ "Losses loaded" at = 1.1
  - ✓ Ceded rate = Minimum rate/margin + (Ceded loss/subject premium) x (1.1), subject to the max rate of 15%
- This feature is an adjustment to PREMIUM – not COMMISSION

Swing Rating Example

Swing rated contract
Min/margin = 3%, losses loaded at 1.1, Max = 15%, Provisional = 10%

Scenario	(1) Probability	(2) Burn	(3) Min/Margin	(4) Loaded Losses	(5) Final Rate	(6) Burn Loss Ratio
1	48.5%	0.0%	3.0%	0.0%	3.0%	
2	20.0%	5.0%	3.0%	5.5%	8.5%	
3	19.5%	7.5%	3.0%	8.3%	11.3%	
4	7.0%	25.0%	3.0%	27.5%	15.0%	
5	5.0%	35.0%	3.0%	38.5%	15.0%	
Total	**100.0%**	**6.0%**	**3.0%**	**6.6%**	**7.1%**	**83.4%**

Notes: (2) Burn = ceded loss to SPI
(4) = (2) x 1.1
(5) = (3) + (4)
(6) = (2) / (5)

Limited Reinstatement Provisions

- Many XOL treaties have reinstatement provisions that cap how many times the cedant can use the risk limit of the treaty
  - ✓ Reinstatements can be free or paid – but choosing to reinstate is almost always mandatory
  - ✓ Just because the limit of the treaty is paid doesn't mean the cedant owes 100% of the reinsurance premium again – could be 1st @ 50%, 2nd @75%, etc.
  - ✓ Catastrophe treaties tend to have 1 reinstatement at 100% - you can reinstate the limit once for the full reinsurance premium
- Limited reinstatements are an implied treaty aggregate limit or treaty cap
- Treaty aggregate limit = risk limit x (1 + number of reinstatements)
- Example $1M x $1M layer with one reinstatement
  - ✓ After the cedant uses up the first $1M limit, they get a second limit
  - ✓ Treaty limit = $1M x (1+1) = $2M
  - ✓ Reinstatement can either be free or paid – depends on contract terms
- Reinstatement premium can be viewed as additional premium reinsurers receive depending on loss experience

Limited Reinstatement Examples

$1M xs $1M Layer
1 reinstatement paid at 100% - Pro rata as to amount, 100% as to time
Upfront ceded premium = $200,000

Example 1

Loss #	Ground Up Loss (000)	Ceded Loss (000)	Reinstatement Premium (000)
1	2,000	1,000	200
2	2,000	1,000	0
3	2,000	0	0
Total	6,000	2,000	200

Example 2

Loss #	Ground Up Loss (000)	Ceded Loss (000)	Reinstatement Premium (000)
1	1,500	500	100
2	1,500	500	100
3	2,000	1,000	0
Total	5,000	2,000	200

Valuing a Limited Reinstatement Premium

$1M xs $1M Layer
1 reinstatement paid at 100% - Pro rata as to amount, 100% as to time

Upfront ceded premium = $300,000

Scenario	Probability	Loss to Layer (000)	Losses After Limitation (000)	Upfront Premium (000)	Reinstatement Premium (000)	Total Premium (000)	Loss Ratio
1	75%	0	0	300	0	300	0%
2	15%	1,000	1,000	300	300	600	167%
3	5%	2,000	2,000	300	300	600	333%
4	3%	3,000	2,000	300	300	600	500%
5	2%	4,000	2,000	300	300	600	667%
Total	100%	420	350	300	75	375	93%

Annual Aggregate Deductible

- The annual aggregate deductible (AAD) refers to layer losses that the cedant retains that would otherwise be ceded to the treaty
- These are the FIRST losses that get paid in a layer – similar to a loss corridor but an AAD is always the first losses
- Example: Reinsurer provides a $500,000 xs $500,000 excess of loss contract. The cedant retains an AAD of $750,000
  - ✓ This means the cedant keeps the first $750,000 of layer losses
  - ✓ If the total loss to the layer = $500,000
    - Cedant retains entire $500,000 (because AAD is $750,000)
    - No loss is ceded to reinsurers
  - ✓ If the total loss to the layer is $1M
    - Cedant retains entire AAD of $750,000
    - Reinsurer pays $250,000
- **If the cedant requests a $500,000 AAD for a treaty, should the actuary reduce the expected layer losses of $1M by $500,000?**

Annual Aggregate Deductible (continued)

- NO! See below

$1M xs $1M Layer
AAD = $500,000
Upfront ceded premium = $300,000

Scenario	Probability	Loss to Layer (000)	After AAD	AAD Savings
1	48.5%	0	0	0
2	20.0%	1,000	500	500
3	19.5%	2,000	1,500	500
4	7.0%	3,000	2,500	500
5	5.0%	4,000	3,500	500
Total	100%	1,000	743	258

- **As with any of these examples, different shaped distributions will result in different savings**

No Claims Bonus (NCB)

- A “No Claims Bonus” provision can be added to an excess of loss contract – it’s exactly what it sound like

- Since any QS contract is apt to have loss ceded to it – because these structures cover losses of all sizes – not just large losses – a no claims bonus doesn’t make sense

- Very binary – if there are no losses, cedant can receive a small % of premium back

- Not a typical feature to see – might see a small no claims bonus on a property catastrophe XOL but the % of premium is small – about 10%
- If there is a small layer loss, cedant has some options:
  - Take the NCB rebate and commute the treaty
  - Wait and see how the layer loss develops

Other Considerations - Rating on a Multi Year Block

- From all of the structures presented, each year's results stand on their own
- For a profit commission, the cedant can have a great year 1 and receive a large profit commission in return. But then maybe year 2 is awful and no PC is paid. Over these two years the cedant may be thrilled but the reinsurer could be in bad shape
- To work to bridge that gap, loss sensitive features can be evaluated using the total treaty experience across multiple years instead. This allows for a smoothing of results and a smoothing of profit commission paid.
- This called rating on a **Multi Year Block**
- Modeling a multi-year block implies tightening up your loss distribution – 3 years of data will tend more towards your mean than just one year – law of large numbers – consider a lower standard deviation

Other Considerations - Deficit/Credit Carryforward Provision

- Another way to effect some kind of loss sensitive smoothing, but for sliding scale commission deals is to use a Deficit or Credit Carryforward provision
- If the loss ratio is SO good and the cedant receives the max ceding commission anyway, the amount that the loss ratio is better than the loss ratio at the max rolls into the next year's calculation. **This is a credit carryforward.**
- If the loss ratio is SO bad and the cedant receives the min ceding commission anyway, the amount that the loss ratio is worse than the loss ratio at the min rolls into the next year's calculation. **This is a deficit carryforward.**
- Similar to a multi-year block, this provision works to smooth out loss sensitive results.
- Read the contract to know how to handle deficit or credit carryovers in an actual treaty.

Determining an Aggregate Distribution – 3 Methods

- Judgmentally select loss ratio outcomes and corresponding probabilities whose weighted average equals your expected loss ratio
  - ✓ May not contain enough bad scenarios if basing your loss ratio outcomes on experience
  - ✓ Easiest to explain to underwriters
  - ✓ Easy but be careful!
- Fit statistical distribution to on-level loss ratios
  - ✓ Reasonable for Pro Rata (QS) treaties
  - ✓ Most actuaries use lognormal distribution
    - Reflects skewed distribution of loss ratios
    - Easy to use
    - Loss ratios are assumed to follow a lognormal distribution which means that the natural log of the loss ratios are normally distributed
- Determine an aggregate distribution by modeling frequency and severity pieces separately and either convolute them or simulate them together
  - ✓ Typically used for excess of loss (XOL) treaties
  - ✓ Lognormal doesn't make sense if you can have zero losses
  - ✓ Lognormal likely not skewed enough for XOL which can be hit or miss depending on the layer

Is the Resulting Distribution Reasonable

- Compare resulting distribution to historical results
  - ✓ On leveled loss ratios should be the focus, but don't completely ignore untrended ultimate loss ratios
  - ✓ Recognize rate action taken, but how do trends impact the results
  - ✓ How volatile have results been?
- Do on leveled loss ratios capture enough cat or shock loss potential?
- Do you think your historical results are predictive of future results?
- Show distribution to underwriters to get their feedback and ultimate agreement
- Sometimes a judgmentally selected discrete distribution makes the most sense and is the easiest to explain

Creating Distributions When There's Cat Exposure

- Is you are pricing a treaty with significant catastrophe exposure you should consider modeling the non-cat loss ratio separately from the cat loss ratio
  - ✓ Non-cat would likely be a straight forward lognormal
  - ✓ Cat is MUCH more skewed – remember earlier example – large chance nothing bad happens, small chance the resulting loss ratio would be large
  - ✓ Combining the cat and non-cat is easy to do during a simulation particularly if you assume they are independent – you can simulate a non-cat result and then a cat result and add together
  - ✓ It is very difficult to find one distribution to address cat and non-cat combined
  - ✓ Since a very skewed distribution leads to a higher loss sensitive cost be careful not to underestimate the value – these things add up
- Even a high CV on your lognormal probably doesn't help – too many very good outcomes to weight back to your expected loss ratio.

What About Process and Parameter Risk (or uncertainty)?

- Process risk is the random fluctuation of results around the expected value just due to the random nature of insurance losses – not every year is going to be the same
- Parameter uncertainty is the fluctuation of results because our parameters used to determine our expected value are never going to be perfect:
  - ✓ Are the trend, rate changes and loss development assumptions reasonable?
  - ✓ For book being priced, are past results a good indication of future results?
    - Changes in mix of business?
    - Change in claims handling?
    - Changes in management or philosophy?
    - Is the book growing? Shrinking? Stable?
- Selected CV should generally be greater than what is indicated as fitted CVs are generally on the low side for modeling
  - ✓ 5 to 10 years of data does not reflect a full range of possibilities
  - ✓ Anything with cat exposure really emphasizes this and needs more scrutiny

Addressing Parameter Uncertainty: One Suggestion

- Instead of choosing one ELR, choose 3 (or more)
- Assign weights to the new ELRs so that they weight back to your original ELR
  - ✓ For example, if your ELR is a 60%, maybe there's a 1/3 chance that your true mean is 50% and 1/3 chance your true mean is 70%
  - ✓ Simulate the true mean by randomly choosing between the 50%, 60% and 70%
  - ✓ Once you're randomly chosen that mean then model using the lognormal based on that chosen mean and your selected CV
  - ✓ Note the CV will handle your process variance
  - ✓ All Set!

Modeling Frequency and Severity Separately

- While a lognormal distribution is relatively easy to use, it is not usually appropriate for XOL treaties
  - ✓ Does not reflect the “hit or miss” nature of many excess contracts
  - ✓ Understates the probability of zero loss
  - ✓ May understate the potential of losses MUCH greater than the expected loss
- Modeling frequency and severity separately is more common or XOL
  - ✓ Simulation (most common)
  - ✓ Numerical methods
- You can use a lognormal for a “working” layer – meaning one where you expect many claims with great certainty

Common Frequency Distributions

- Poisson is an easy to use distribution to model expected claim count
  - ✓ Poisson distribution assumes the mean (lambda) and variance of the claim count distribution are equal
  - ✓ Discrete distribution – number of claims = 0, 1, 2, 3, etc.
- Despite the Poisson's ease of use, Negative Binomial more preferred
  - ✓ Same form as the Poisson except that lambda is no longer considered fixed but rather has a gamma distribution around lambda
  - ✓ Variance is greater than the mean
  - ✓ Preferred over Poisson because it reflects a little more parameter uncertainty regarding the true mean claim count
  - ✓ The extra variability of the Negative Binomial is more in line with historical experience

Common Severity Distributions

- Lognormal
- Mixed Exponential Pareto
- Truncated Pareto
- CAVEAT – if you are fitting a severity distribution to actual claims don't forget about loss development

Conclusion

- There are many loss sensitive features available that can be used to make a reinsurance treaty acceptable to both the cedant and the reinsurer
- It's up to the actuary to value the requested features and explain the results to underwriters
- Depending on the shape of your loss distribution, your loss sensitive feature's expected cost or savings can vary greatly
- A little sensitivity testing on a arrange of distributions can go a long way!

Limitations

The views expressed in this presentation are those of the presenter and not those of Milliman or the Casualty Actuarial Society (CAS). Nothing in this presentation is intended to represent a professional opinion or be an interpretation of actuarial standards of practice.

Thank you

Patty Kinghorn
Patty.kinghorn@milliman.com

Bibliography