LOSS SENSITIVE TREATY FEATURES

CAS Boot Camp on Reinsurance Pricing Techniques

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Goals for today

- Define the term: loss sensitive feature
- Purpose: Resolve differing views on pricing and risk
- How to value loss sensitive features: QS, XOL
- Describe basic tools for simulation
- Question time

THE BASICS

Define "loss sensitive features"

Features by treaty type

Zooming in : profit commissions

Definition

- Loss sensitive features in a reinsurance contract:
  - Adjust treaty behavior based on loss experience, to bridge loss pick gaps in pricing negotiations
  - Can affect ceded premium, losses, or expenses
  - Can be combined to create incentives to manage the quality of the subject book of business
- Premiums or commissions start at “provisional” level
  - Index up or down in response to loss activity
- Loss terms may involve sharing losses among parties
  - Degree and type of loss sharing affects final cost

Why loss sensitive terms?

- Treaty pricing aim: Leave everyone “equally unhappy”
- Reinsurer loss picks can seem high to ceding insurers
  - Reinsurers conservative due to lack of information
  - Insurer is confident about underwriting expertise
- Loss sensitive terms make a treaty placement viable
  - Adjust initial premium/commissions retrospectively
  - Limit exposure in exchange for rate concession
- Any concessions are conditional on good experience
  - Loss sensitive terms can settle “bets” on loss picks
  - Each side needs to know the value of these bets

Types of loss sensitive terms?

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- Ceded Premium “concessions” made possible by terms that adjust premiums retrospectively as losses come in
  - Reinstatement provisions, or additional premiums
  - Swing-rated contracts
- Ceded Commission: Sliding scale ceding commission and profit commissions even things up via commission adj’s
- Ceded Loss features directly affect exposure to treaty, cutting premiums by reducing dollar-trading
  - Annual aggregate deductibles (AAD)
  - Loss ratio corridors and caps
  - 2nd or 3rd event covers can have specific triggers

Features used by treaty type

- Pro rata / QS treaties
  - Profit commission
  - Sliding scale
  - Loss corridor (%, $)
  - Aggregate cap (%, $)
  - Event cap
- Excess of Loss (XOL)
  - Profit commission
  - Reinstatements
  - Swing rating plans
  - No Claims Bonus
  - AADs
  - Annual Agg Limits ($)
  - Loss Ratio Cap (%)
  - *Experience funds* (out of scope ☹)

Profit commission

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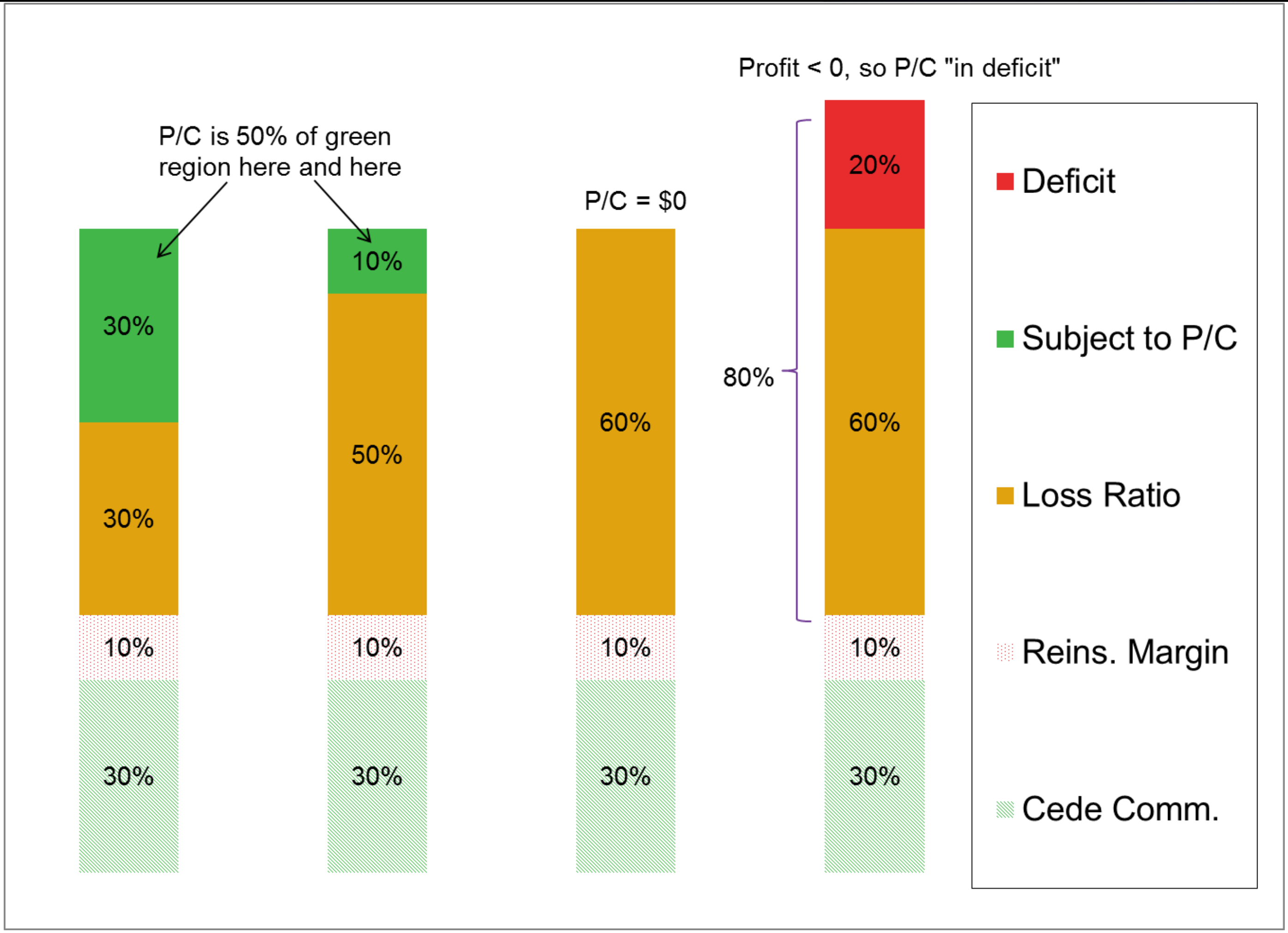
- Used in Quota Share or XOL to reward good results, so it can be used to settle pricing disputes
  - Idea: Cedent gets defined share of treaty "profit"
- Profit formulas vary, but typically
  - Profit = Premium – Loss – Commission – Margin
  - "Margin" is a provision for reinsurer expenses
- PCs often given using shorthand: "50 after 10" (%)
  - With flat ceding commission of 30%, we have
  - Profit (%) = (1 – 30% CC –10% RM – LR%)
  - So PC % = 50% × max(0, 60% - Loss Ratio %)

Profit commission "illustrations"

- "50 after 10"
- 30% "cede"
- 10% "margin"
- Loss Ratios:
  - 30%, 50%, 60%, 80%.
- Last case 80% LR lands in "deficit"



Profit commission – value?

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- Question: What's the ***expected*** cost of the PC?
- Suppose the treaty ELR is 60%, where PC is zero
  - Does this imply that expected cost of PC is zero?
- Uh, no. Expected Cost(PC) ≠ PC at Expected LR
- Why? Don't cite Jensen's Inequality. Show us and tell us.
  - 60% is the ***expected*** LR, not the only possible LR
  - There's a probability distribution around the ELR
  - Some possible values trigger payments on PC
- Numerical illustrations, pictures and animations help you drive your point home. Use these tools to communicate.

Profit commission – oversimplified example

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- Profit Commissions are a one-way street. They pay in good times, but don't surcharge in bad years.
- California property QS with EQ exposure (all/nothing)
  - Non-Cat ELR = 40% (certain)
  - PC is 50 after 10, net of 30% ceding commission
  - Cat (EQ) ELR = 30%, based on at most 1 EQ/yr
    - (LR | No EQ) = 0%, Pr[No EQ] =90%
    - (LR | EQ) = 300%, Pr[EQ] = 10%
- Results: What's the value of PC with and without EQ?
- Expected cost PC: 10% × PC(EQ) + 90% × PC(No EQ)

Profit commission – oversimplified example answers

Answers: **Did you get these?**

- With 50 after 10, and a 30% Cede
  - PC | No EQ = 0.5 × (1 – 30% –10% – 40% – 0%)
    - Value is 10%. Right?
  - PC | EQ = 0.5 × (1 – 30% – 10% – 40% – 3%)
    - Profit is quite negative, so PC = 0.
- Expected cost PC: 10% × PC(EQ) + 90% × PC(No EQ)
  - 90% × 10% + 10% × 0% = 9% of Ceded Premium

VALUATION PRINCIPLES

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General workflow

Loss sensitive features on pro rata treaties

Loss sensitive features on XOL treaties

Comments on multi-year terms

General workflow: Cost / benefit of loss sensitive features

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- Create an Aggregate Loss Distribution
  - Think of it as a discrete list of possible Loss Ratio outcomes with assigned probabilities
- You can fit adjusted historical premium/loss data to curve
    - Aggregate loss ratio distribution (e.g. Lognormal)
    - Fit Frequency/Severity distributions and simulate
  - Detailed curve-fitting is out of scope ☹
- Apply loss sensitive terms at each table row or scenario
- Find probability-weighted average cost (benefit) of the loss sensitive features in the contract

Profit commission: "50 after 10" revisited: 30% Cede, 60% ELR

	Prob	LR	Cede	Cost of PC at LR	UW Ratio
1	4.0%	25.0%	30.0%	17.5%	72.5%
2	10.0%	35.0%	30.0%	12.5%	77.5%
3	20.0%	40.0%	30.0%	10.0%	80.0%
4	25.0%	50.0%	30.0%	5.0%	85.0%
5	20.0%	60.0%	30.0%	**0.0%**	90.0%
6	15.0%	70.0%	30.0%	0.0%	100.0%
7	2.0%	80.0%	30.0%	0.0%	110.0%
8	2.0%	145.0%	30.0%	0.0%	175.0%
9	1.0%	350.0%	30.0%	0.0%	380.0%
10	1.0%	450.0%	30.0%	0.0%	480.0%
Total	100.0%	60.0%	30.0%	**5.2%**	95.2%

- Once again, we can see that Expected Cost of PC is not equal to the PC Cost evaluated at the Expected Loss Ratio.

Huh? Why doesn't this work?

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- Key point: Loss distribution determines the answer
  - Distribution assigns probability to each LR value
  - Loss ratio determines PC ($) for scenario or value
- With skewed distributions seen in reinsurance, you may often pay the cedent under a PC arrangement
  - Esp. true for XOL, but you always need lots of favorable scenarios to balance extreme scenarios
  - Favorable scenarios are the ones that trigger PC
- Loss distribution drives all of your pricing. Take care.
  - Loss sensitive feature cost estimates and overall treaty pricing assumptions must line up (not easy)

Profit commission: Vary the loss distribution assumption

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	Prob	LR	Cede	Cost of PC at LR	UW Ratio
1	0.0%	25.0%	30.0%	17.5%	72.5%
2	1.0%	35.0%	30.0%	12.5%	77.5%
3	15.0%	40.0%	30.0%	10.0%	80.0%
4	25.0%	50.0%	30.0%	5.0%	85.0%
5	30.0%	60.0%	30.0%	**0.0%**	90.0%
6	20.0%	70.0%	30.0%	0.0%	100.0%
7	6.0%	80.0%	30.0%	0.0%	110.0%
8	3.0%	145.0%	30.0%	0.0%	175.0%
9	0.0%	350.0%	30.0%	0.0%	380.0%
10	0.0%	450.0%	30.0%	0.0%	480.0%
Total	100.0%	60.0%	30.0%	**2.9%**	92.9%

- What if your loss distribution is more like this?

Profit commission: Vary the loss distribution assumption

	Prob	LR	Cede	Cost of PC at LR	UW Ratio
1	0.0%	25.0%	30.0%	17.5%	72.5%
2	0.0%	35.0%	30.0%	12.5%	77.5%
3	0.0%	40.0%	30.0%	10.0%	80.0%
4	33.3%	50.0%	30.0%	5.0%	85.0%
5	33.3%	60.0%	30.0%	**0.0%**	90.0%
6	33.3%	70.0%	30.0%	0.0%	100.0%
7	0.0%	80.0%	30.0%	0.0%	110.0%
8	0.0%	145.0%	30.0%	0.0%	175.0%
9	0.0%	350.0%	30.0%	0.0%	380.0%
10	0.0%	450.0%	30.0%	0.0%	480.0%
Total	100.0%	60.0%	30.0%	**1.7%**	91.7%

- Or maybe like this?

Loss sensitive features for QS (proportional) treaties

- Pro Rata: Quota Share, Surplus Share treaties
  - Profit commission (seen this already)
  - Sliding scale commission
  - Loss corridor
  - Loss ratio cap
- Event caps can be written into QS contract
  - Usually applies when QS is underneath XOL
  - Use net aggregate loss distribution after XOL, including mass point created at XOL retention.
  - So this is really an XOL topic, not purely QS

Sliding scale commissions

- Applies when parties disagree on the loss ratio pick
  - Provisional Cede paid at start pegged to implied ELR (say, "30 at a 60"), then "slides" with LR
  - Adjusts **up** as the LR goes **down**, up to a Max
  - Adjusts **down** as the LR goes **up**, down to a Min
- In good years, slide increases cedent net profit by lowering net expense, so net leverage unaffected.
- In bad years, reinsurer gets some margin protection from rebated commission.
- "*Put your money where your mouth is*" provision.

Sliding scale example

- Suppose sliding scale terms are given by this table:

	Cede	@	LR	Cede + LR	Margin
Min	15%	@	75%	90%	10%
Prov	20%	@	65%	85%	15%
Max	25%	@	60%	85%	15%

- Provisional Cede “20 at a 65” goes up/down with LR
- If the Loss Ratio turns out to be:
  - < 65%: Slides up 1:1 for each 1% LR drop to 25%
  - > 65%: Drops by ½:1 each add’l +1% LR to 15%
- Question: So… If ELR = 60%, is the Expected Ceding Comm. equal to Ceding Comm. at Expected LR?

Value a sliding scale commission

	Prob	LR	Cede	UW 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%

- Again, E[Commission] ≠ Commission @ Expected LR

Loss ratio corridor

- Provision assigns all (or part) of losses in a given LR range (“corridor”) to be retained by ceding company
  - Roughly speaking: “I bleed, you bleed” approach
  - Not as common as slides
- Example: Cedent keeps 100% of losses when LR is 75% to 85% – “10 point corridor attaching at 75%”
  - Subject LR = 75%: Ceded LR = Subject LR = 75%
  - Subject LR = 80%: Ceded LR = 75%
  - Subject LR = 85%: Ceded LR = <wait> 75%
  - Subject LR = 100%: Ceded LR = ???
- Note: Corridor does not have to be 100% retained

Loss ratio cap

- Provision assigns a maximum Ceded LR for treaty
  - Once you hit the aggregate cap, the party's over
- Example: QS with 200% loss ratio cap
  - Ceded LR before cap = 150%: Ceded LR = 150%
  - Ceded LR before cap = 300%: Ceded LR = 200%
- Useful on start-ups: Limit / Premium can be volatile
  - New Umbrella program offers $10M policy limits, but only writes $3M in premium in first year of operation
  - Can be the only way to get the treaty placed.
  - While the cap may be set high, at least downside is limited
- Note: See your auditor for an opinion on risk transfer.

Breathe

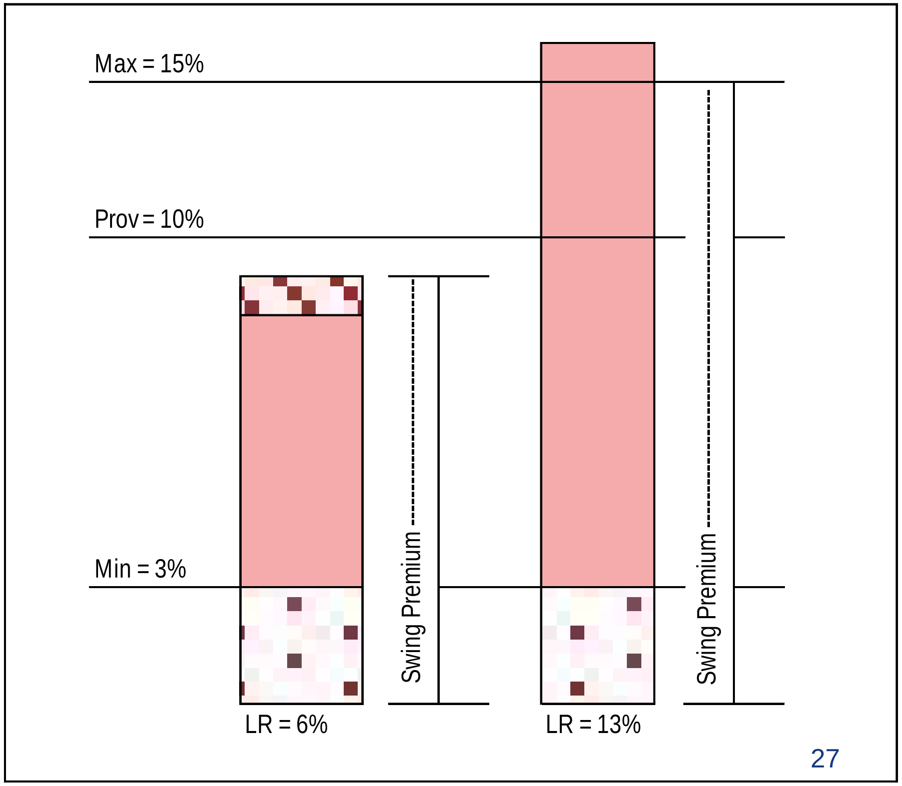
Loss sensitive features on XOLs

- Excess of loss (XOL) treaties
  - Profit commission (seen this before)
  - Swing rates
  - Reinstatements and Aggregate Limits
  - Annual Aggregate Deductibles
  - No Claims Bonuses (if anywhere, Cat XOLs)
  - Loss ratio cap (seen this before)

Swing rating provisions

- Swing rates set a provisional Ceded Premium, then dials it up/down with later adjustments based on ceded losses
  - Terms can vary. Read the contract to see how it works.
- Typical Swing (Rates ~ % SPI)
  - Provisional Rate = 10%; Minimum Rate/Margin = 3%; Maximum Rate = 15%
  - "Losses Loaded" at = 1.1
- Ceded Rate = Minimum Rate + Ceded Loss % x 1.1, subject to Max Rate of 15%
- Question: What Ceded Loss % puts you at the Maximum Rate?

Answer



Swing rating example

Swing Rated Contract							
Min / Margin = 3%, Losses Loaded at 1.1, Max = 15%, Provisional = 10%							
	Prob	Burn	Final Rate	LR			
1	48.5%	0.0%	3.0%				
2	20.0%	5.0%	8.5%				
3	19.5%	7.5%	11.3%				
4	7.0%	25.0%	15.0%				
5	5.0%	35.0%	15.0%				
Total	100.0%	6.0%	7.1%	83.4%			
Burn = Ceded Loss to SPI							

Limited reinstatement provisions

- Many XOL treaties have reinstatement provisions that cap the number of times you can tap the treaty's risk limit.
  - Reinstatements can be free or paid
  - Paid reinstatements are based on the initial premium, as in 1^{st} @ 50%, 2^{nd} @75%, etc.
  - Catastrophe treaties often have "1@100%"
    - One full reinstatement of the limit for the full premium
- Limited reinstatements imply an annual aggregate limit.
- Treaty Aggregate Limit = Risk Limit x (1+ # reinstatements)

Limited reinstatement provisions

- Example: $1M x $1M layer with one reinstatement
  - As the first $1M limit, a second limit becomes available
  - Treaty Aggregate Limit = $1M x (1 + 1) = $2M
  - Reinstatements can be free or paid – Read the contract
  - “Free” is a euphemism for “Prepaid”
- Many Property Cat XOLs have limits that are exhausted in the aggregate. Reinstatements are “pro rata as to Amount”
  - Pay next reinstatement premium proportionally as you use the current limit. On final limit, premium is paid up.
- Summary: Reinstatement premium is an additional premium that reinsurers receive depending on loss experience

Limited reinstatement example

$1M x $1M Layer						
1 reinstatement paid at 100% - Pro rata as to amount, 100% as to time						
Upfront Ceded Premium = $200,000						
	Year 1			Year 2		
	Ground up Loss	Ceded Loss	Reinst. Prem	Ground up Loss	Ceded Loss	Reinst. Prem
1	2,000	1,000	200	1,500	500	100
2	2,000	1,000	-	1,500	500	100
3	2,000	-	-	2,000	1,000	-
Total	6,000	2,000	200	5,000	2,000	200

Valuing a limited reinstatement provision

$1M x $1M Layer							
1 reinstatement paid at 100% - Pro rata as to amount, 100% as to time							
Upfront Ceded Premium = $300,000							
	Prob	Loss to Layer	Losses after limitation	Upfront Premium	Reinst. Premium	Total Prem	LR
1	75.0%	-	-	300	-	300	
2	15.0%	1,000	1,000	300	300	600	
3	5.0%	2,000	2,000	300	300	600	
4	3.0%	3,000	2,000	300	300	600	
5	2.0%	4,000	2,000	300	300	600	
Total	100.0%	420	350	300	75	375	93%

Annual Aggregate Deductible

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- Annual Agg. Deductible (AAD): Added barrier of retained **in-layer** losses that would otherwise go to the treaty
  - AAD eliminates the **first** losses to hit the layer
  - Similar to loss corridor, but AAD always hits first
- Example: XOL cover: $500 x $500 XOL and AAD of $750
  - Total Loss to Layer = $500?
    - Cedent retains entire $500. Ceded loss = $0
  - Total Loss to Layer = $1M?
    - Cedent retains $750, Reinsurer pays $250
- Question: If we impose a $500 AAD, should the actuary reduce her expected layer losses of $1M by $500?

Uh… No! (But you knew that, right?)

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$1M x $1M Layer				
AAD = $500,000				
	Prob	Loss to Layer	After AAD	AAD Savings
1	48.5%	-	-	-
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	100.0%	1,000	743	258

As with any of these examples, a different loss distribution would result in different estimated savings.

No Claims Bonus

- A No Claims Bonus provision can be added to an excess of loss contract – it's exactly what it sounds like
- QS contracts usually attach at first dollar of loss
  - A no claims bonus doesn't make much sense
- Very binary: If there are no losses, cedent can receive a small % of premium back
- If there is a small layer loss, we have a conundrum:
  - Take the NCB rebate, and **commute** the treaty.
  - Wait and see how the layer loss develops.
- Not typical feature in Casualty, but it could be useful in Property Catastrophe XOLs that are well off the ground.

Using loss sensitive features in multi-year blocks

- In all structures presented thus far, each year's results stands on its own.
- Example: XOL with a PC over consecutive years.
  - Year 1 is light (PC pays in full). Year 2 has big losses.
  - Nice for cedent. Reinsurer is hammered from both ends.
- To smooth results and get better rates, loss sensitive terms can apply to total treaty experience across multiple years.
  - E.g., multi-year PC or slide, "2 full limits over 3 years"
- This is called rating on a **Multi Year Block**
- Modeling a multiyear block requires more care in setting your loss distribution. A lot can happen in 3 dice rolls.

Deficit / credit carryforward (especially for sliding scales)

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- Sliding scale commissions can also get out of balance, but can be tamed over time with a deficit/credit carryforward
- If a low LR triggers the max commission, any spillover can roll into next year's slide calculation as a **credit** carryforward.
- Likewise, the excess portion of a high LR can roll into next year as a **deficit** carryforward.
- Typical sliding scale format is given at right.
- Read the contract to know how to handle deficit or credit carryovers in an actual treaty.

	Cede	@	LR
Min	15%	@	75%
Prov	20%	@	65%
Max	25%	@	60%

VALUATION NUTS AND BOLTS

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- Aggregate loss distributions and valuation
- Fooling yourself: Process and parameter uncertainty
- What if there’s Cat or large loss exposure?
- Frequency/Severity modeling
- How do I get started in simulating loss distributions?

Determining an aggregate loss distribution (3 methods)

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- Discrete distribution with hand-picked LR points and judgmentally selected probabilities – when you can't fit.
  - Easy to explain to underwriters, buyers, brokers
  - Care is needed to include enough extreme values
- Fit parametric probability distribution to on-level LRs
  - Can work reasonably well for QS on Gross
  - Actuaries like lognormal: easy, somewhat skewed
- Fit frequency/severity: Simulation / convolution
  - Useful for XOL, Cat-exposure, QS with event cap
  - Lognormal can't do loss-free years, and it's too "light"

Judgmentally selected aggregate loss distribution

	Prob	LR	Cede	UW 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%

Lognormal distribution: ELR = 60%, SD = 10%

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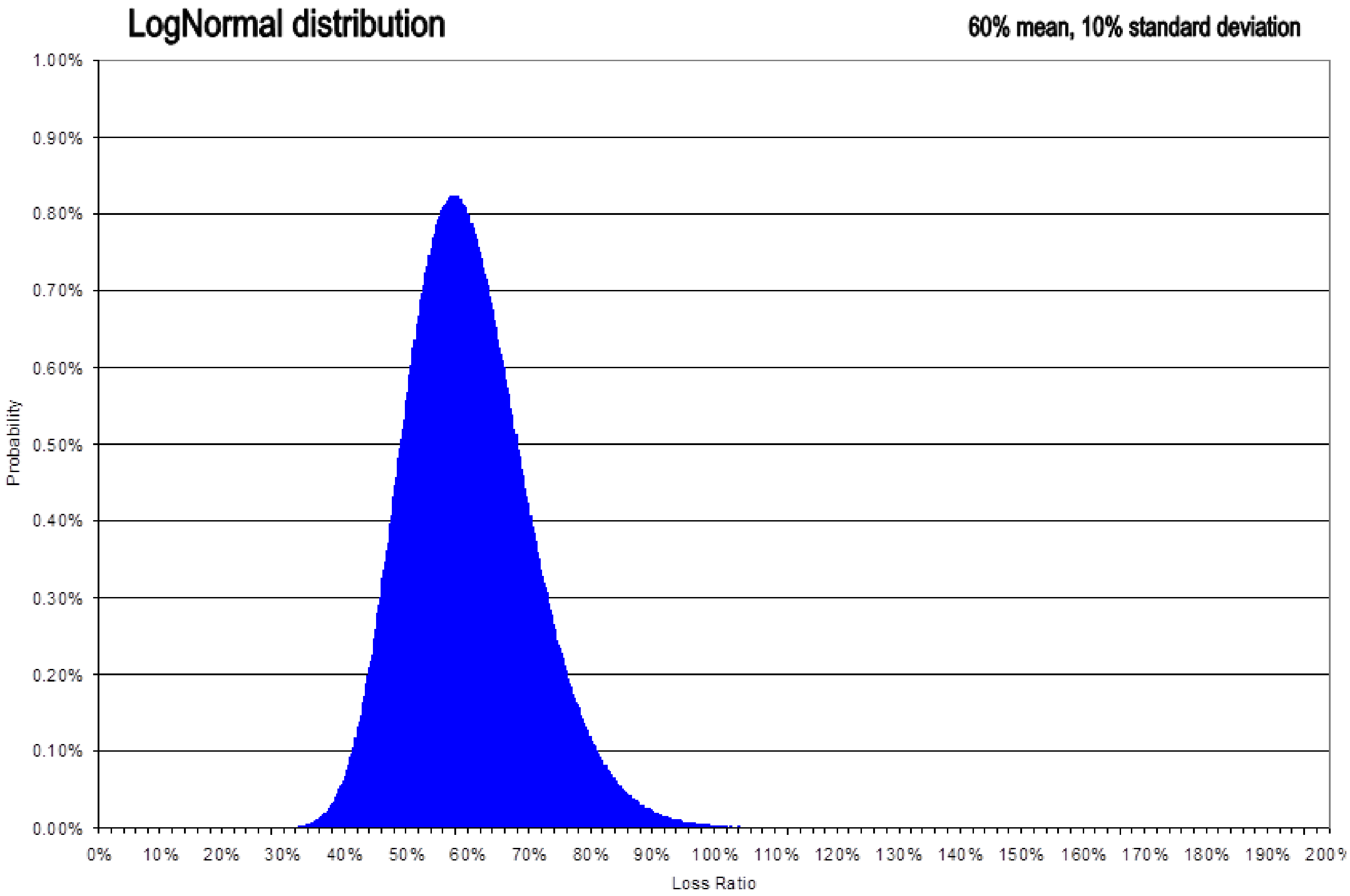
Cumul Prob	Increm Prob	LR
10.0%	10.0%	48%
20.0%	10.0%	52%
30.0%	10.0%	54%
40.0%	10.0%	57%
50.0%	10.0%	59%
60.0%	10.0%	62%
70.0%	10.0%	64%
80.0%	10.0%	68%
90.0%	10.0%	73%
95.0%	5.0%	78%
99.0%	4.0%	87%
99.6%	0.6%	92%
99.9%	0.3%	98%
Total	100%	60%

Ad: To get a better fit to historical experience, try a **shifted Lognormal**.

Lognormal distribution: ELR = 60%, SD = 10%



Lognormal distribution: ELR = 60%, SD = 20%

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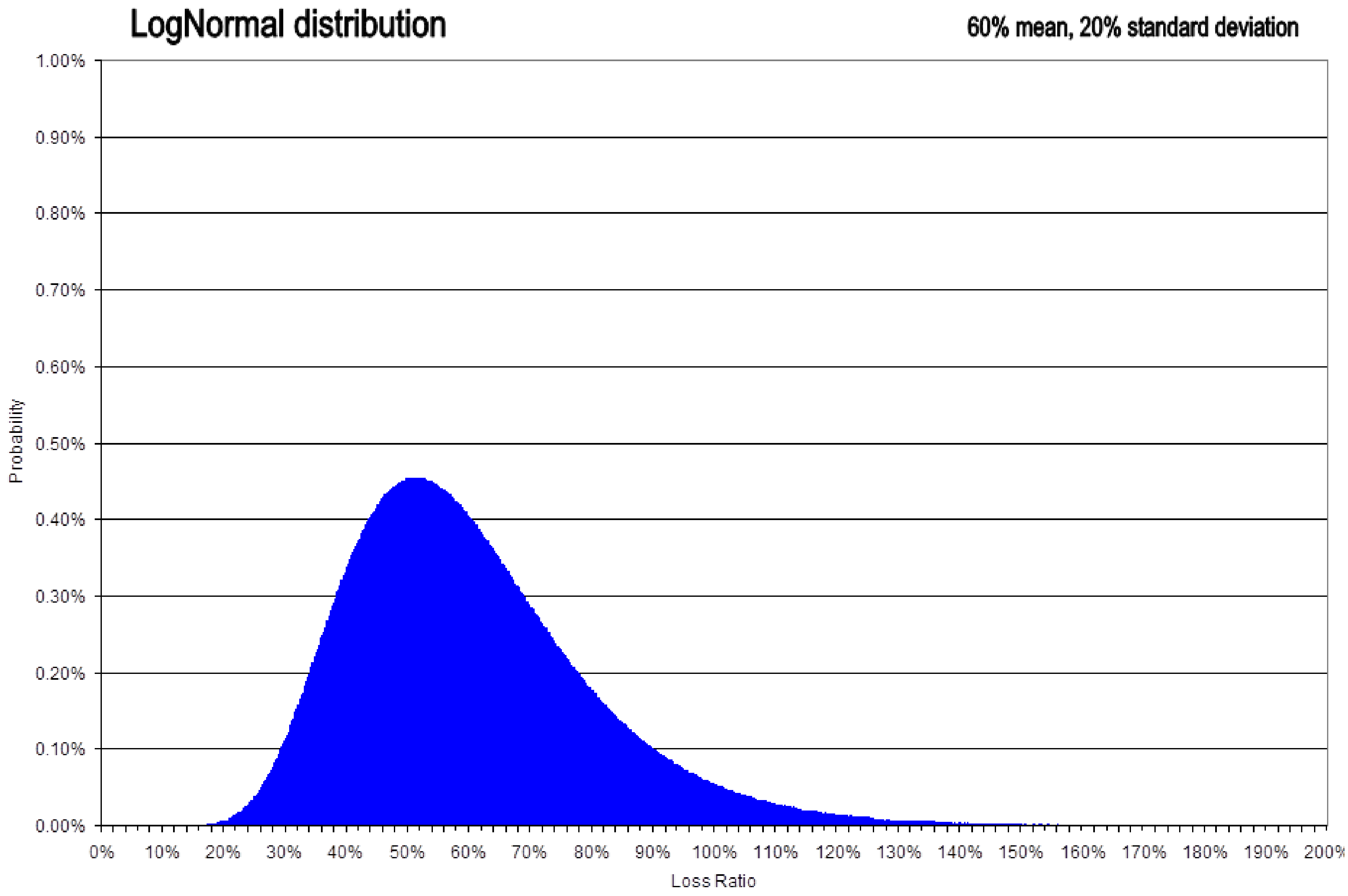
Cumul Prob	Increm Prob	LR
10.0%	10.0%	38%
20.0%	10.0%	43%
30.0%	10.0%	48%
40.0%	10.0%	52%
50.0%	10.0%	57%
60.0%	10.0%	62%
70.0%	10.0%	68%
80.0%	10.0%	75%
90.0%	10.0%	86%
95.0%	5.0%	97%
99.0%	4.0%	122%
99.6%	0.6%	135%
99.9%	0.3%	157%
Total	100%	60%

Lognormal distribution: ELR = 60%, SD = 20%



Normal distribution: ELR = 60%, SD = 20%

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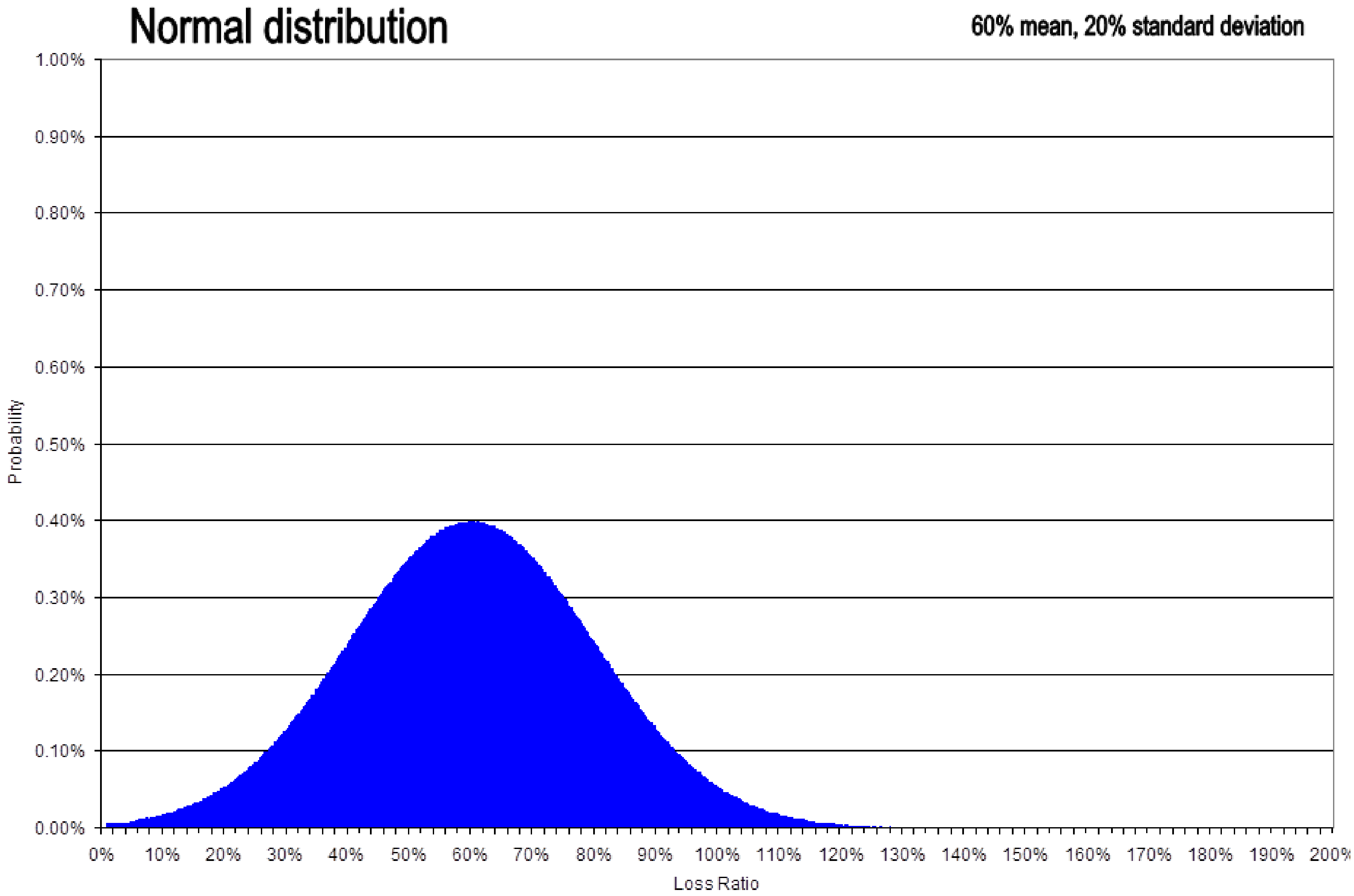

Lognormal distribution: ELR = 60%, SD = 30%

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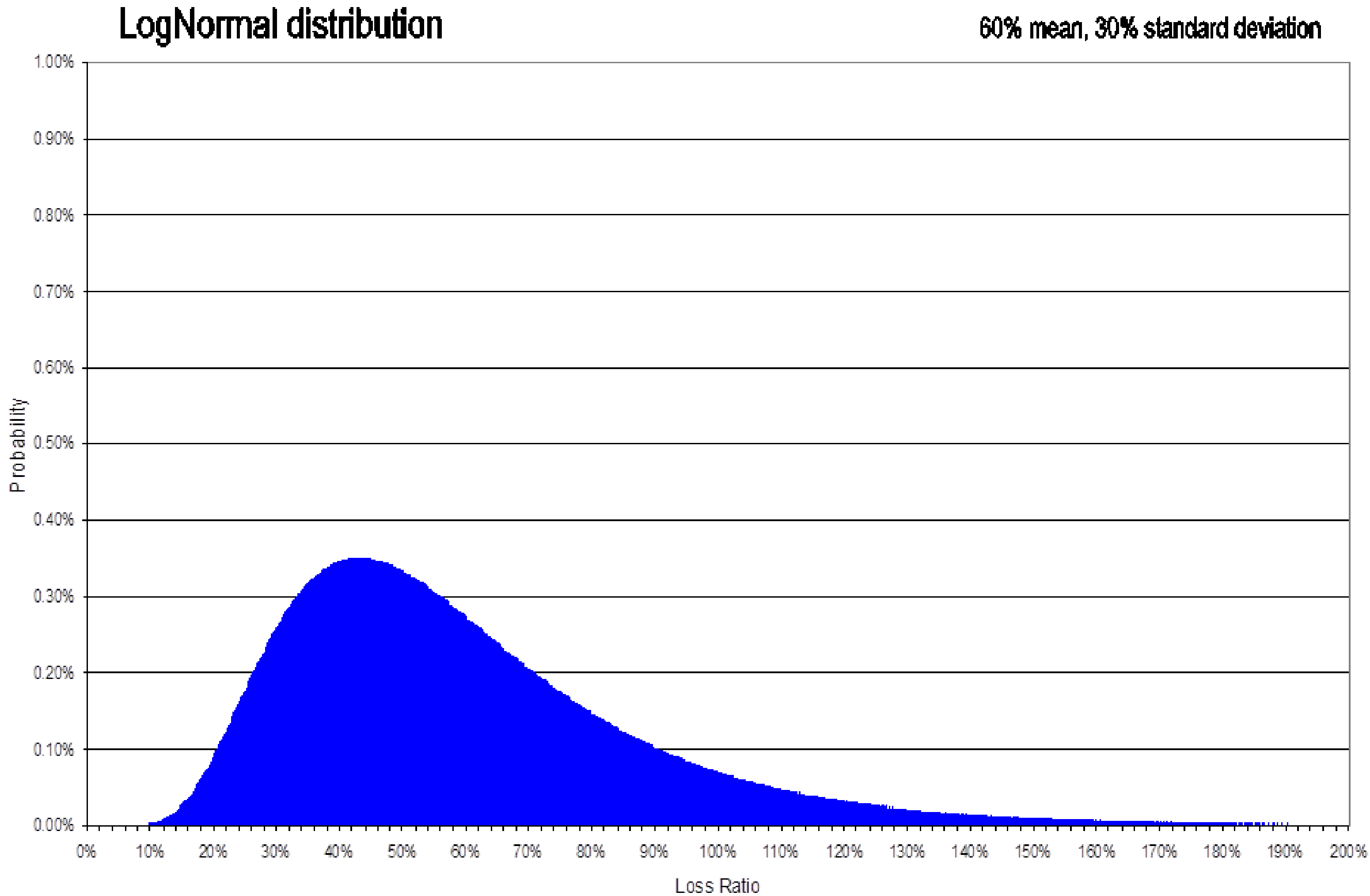
Cumul Prob	Increm Prob	LR
10.0%	10.0%	29%
20.0%	10.0%	36%
30.0%	10.0%	42%
40.0%	10.0%	47%
50.0%	10.0%	54%
60.0%	10.0%	61%
70.0%	10.0%	69%
80.0%	10.0%	80%
90.0%	10.0%	99%
95.0%	5.0%	115%
99.0%	4.0%	160%
99.6%	0.6%	184%
99.9%	0.3%	218%
Total	100%	60%

Lognormal distribution: ELR = 60%, SD = 30%



Is my loss distribution reasonable?

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- Reality check: compare to historical results
  - On-level LRs are focus, but check untrended ultimate LRs for patterns you may have missed
  - Do results show volatility beyond rate actions, underwriting measures, rate mods, trends, etc.?
- Do on-level LRs reflect enough downside potential?
  - Cats, shock loss, unexpected frequency jumps
  - Are results in experience period really predictive?
- Does your distribution fly with underwriters, buyers?
- In some cases, you may have to throw out your fitted curve and pick one judgmentally with your group.

What about this process risk and parameter uncertainty?

- Process risk is the random fluctuation of results around the expected value just due to the random nature of insurance
  - Not every year is going to be the same!
  - Even if we had a Groundhog Day world, there are many possible ways for the next period to play out
- Parameter uncertainty is the fluctuation in results because our fitted parameters used in our loss distribution are never going to be perfect.
  - Even with the right model, we don't have enough observations to give precise parameter estimates
  - We could be wrong about the model. Be humble.

Parameter uncertainty: Don't stop being an actuary when modeling

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- Parameter uncertainty comes in through many doors.
  - Trend, rate changes, loss development assumptions – reasonable and representative?
  - For this book, will the future be like the past?
    - Changes in mix? Changes in claims handling?
    - Change in management or philosophy?
    - Is the book growing? Shrinking? Stable?
- Fitted CVs are generally on the low side for modeling
  - 5 - 10 years of Loss Ratios can't cover the full range of even reasonably-expected possibilities
  - Anything with Cat exposure really needs scrutiny

Addressing parameter uncertainty with a simple prior distribution

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- When the mean is "fuzzy", don't stop at just one value for the Expected LR, try several ELRs. Here's how…
- Assign probability weights to the new ELRs so that they all weight back to your original ELR (say, 60%).
  - Let ELR ~ [50%, 60%, 70%], and each has 1/3 chance of being the true mean, and do a 2-stage simulation
  - For each step, randomly select the conditional mean (i.e., 50%, 60%, or 70%), then set the aggregate loss as a Lognormal with this mean and your selected CV
  - Note that the CV covers your "process variance"
- Other "priors" may be better/worse, but you get the idea

Creating distributions when there is Cat exposure

- If your treaty covers Cat-exposed business, you need to try to model non-Cat and Cat risks separately
  - Non-Cat "attritional" loss ~ Lognormal LR(μ,σ)
  - Cat losses are much more skewed, and "binary"
- Event-based Cat models fit nicely into simulation
  - Combines Cat, Non-Cat and other risks easily
  - Scenarios let you illustrate loss sensitive features
  - Lets you easily separate effects of Cat vs. Non-Cat
- Lognormal model for combined risk is a dead end
  - Hard to calibrate and explain. Easy to screw up.

Modeling frequency and severity separately

- While a lognormal aggregate loss distribution is relatively easy to use, it is not usually appropriate for XOL treaties
  - Does not reflect “hit or miss” nature of XOL contracts
  - Ignores the possibility of loss-free years
  - Too light-tailed to account for extreme scenarios
  - Understates the potential of losses MUCH greater than the expected loss
- Modeling Frequency and Severity separately is more common for XOL
  - Usually large losses are simulated individually
  - “Attritional” losses modeled in bulk as LR model

Common frequency distributions

- Poisson is an easy-to-use distribution to model claim counts
  - Poisson distribution assumes the mean (λ, constant) and variance of the claim count distribution are equal
  - Discrete distribution for # claims = 0, 1, 2, 3, etc…
- Negative Binomial: Poisson with parameter uncertainty
  - Think of a Poisson with Λ ~ Gamma random variable
  - Mean is still λ, but variance = $\lambda(1 + \lambda c) > \lambda$ ($c > 0$).
  - Preferred because it fits a wider variety of situations
  - The extra variability of the Negative Binomial is more in line with historical experience
- Delaporte distribution: Call me when you get this far.

Common severity distributions

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- Lognormal
- Mixed Exponential (currently used by ISO)
- Pareto
- Truncated Pareto – was used by ISO before moving to the Mixed Exponential
- CAVEAT: If you are fitting a severity distribution to actual claims, don't forget about loss development! (Maybe use ISO curves instead of building your own)

How do I simulate losses?

- Simulation software: Almost too many choices
  - Excel can do simulations by itself, or with VBA
  - @ Risk, Crystal Ball, MATLAB, R, Python/NumPy
  - Vendor products: Risk Explorer, ADVISE, DIVA
  - Some broker products: MetaRisk, Remetrica
  - Numerical Methods: Use FFT or Heckman-Meyers
- You can use a Lognormal or Gamma for layer losses
  - Parameters would imply implicit frequency/severity
  - It is not that hard to do simulation, once you know some probability concepts and interpretation principles

Concluding remarks

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- There are many loss sensitive features available to help break logjams in reinsurance pricing disputes
- It's up to the actuary to value the requested features and explain the results to underwriters and buyers
- Depending on the loss distribution, your loss sensitive feature's expected cost or savings can vary **greatly**
- A little sensitivity testing on a range of distributions will keep you out of trouble.
- Use lots of illustrations to show how these work.
  - We have computers now. Try an animation in your show & tell to help everyone "see" the risks.

Loss Sensitive Treaty Features

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