

MANAGING EXTREMES

Willis Re

AN ACTUARIAL MODEL OF EXCESS OF POLICY LIMITS LOSSES

Seminar on Reinsurance

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Agenda

- Goal
- Background & motivation
- Proposed model
- Analysis and discussion
- Numerical example
- Conclusion

Goal

- Calculate XPL loss cost in XOL layer
- Practical
- Integrated into
 - Traditional exposure rating
 - Standard XOL reinsurance pricing software

BACKGROUND & MOTIVATION

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Background & motivation

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- You
 - Are a reinsurance pricing actuary
 - Price treaties covering Excess of Policy Limits (XPL) losses
 - Do not have credible data
 - Use exposure rating
- Does your exposure rating tool calculate a loss cost for XPL?

Background & motivation

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- How to price for XPL exposure: are there any actuarial papers?
- Braithwaite and Ware
 - Build a standalone, specialized curve for XPL/ECO
 - Get lots of claims data, fit frequencies and severities
 - How to price a clash cover; not what we're interested in
 - Not practical
 - Not connected to working layer loss curves

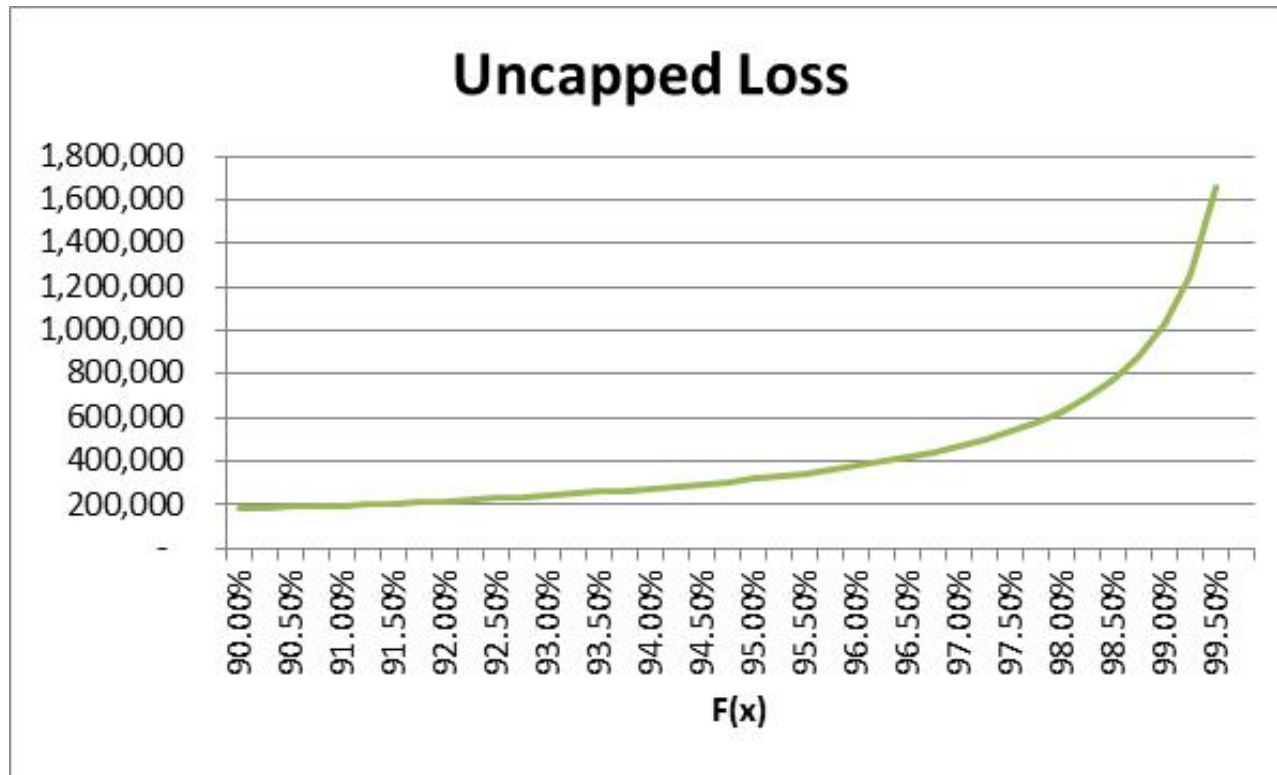
PROPOSED
MODEL

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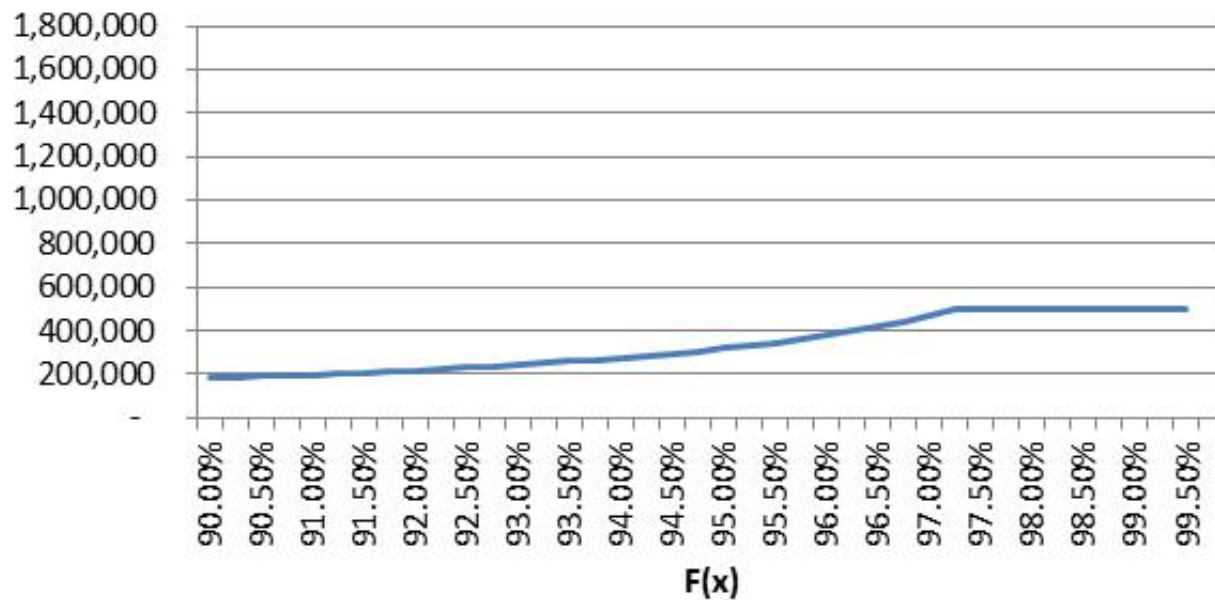


Traditional model

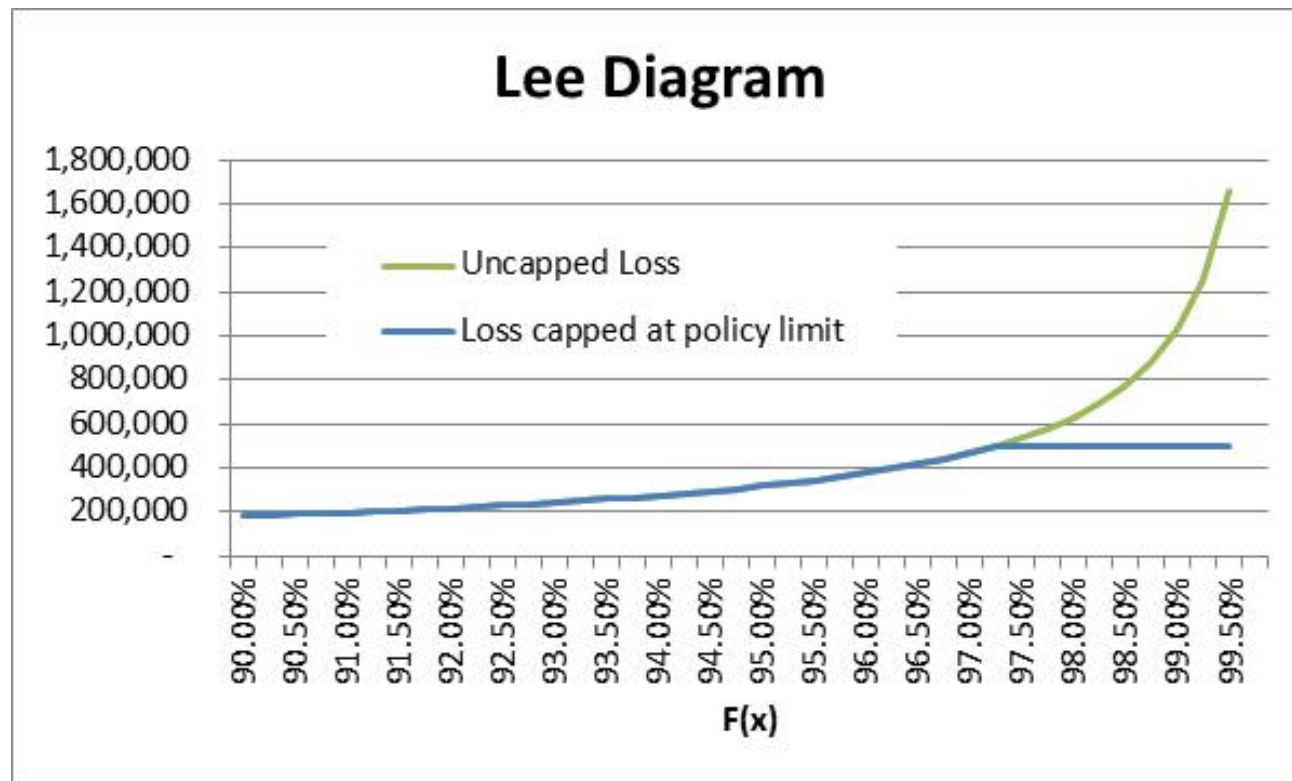


Traditional model

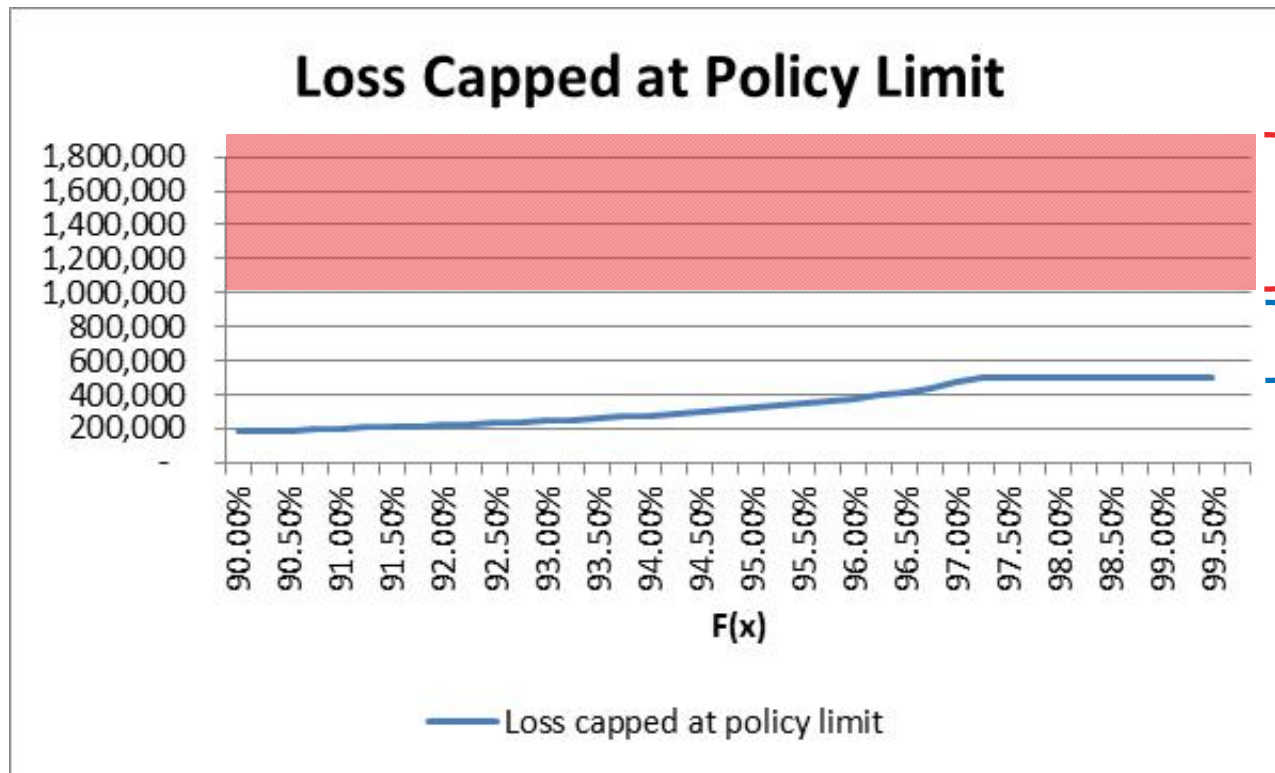
Loss Capped at Policy Limit



Traditional model



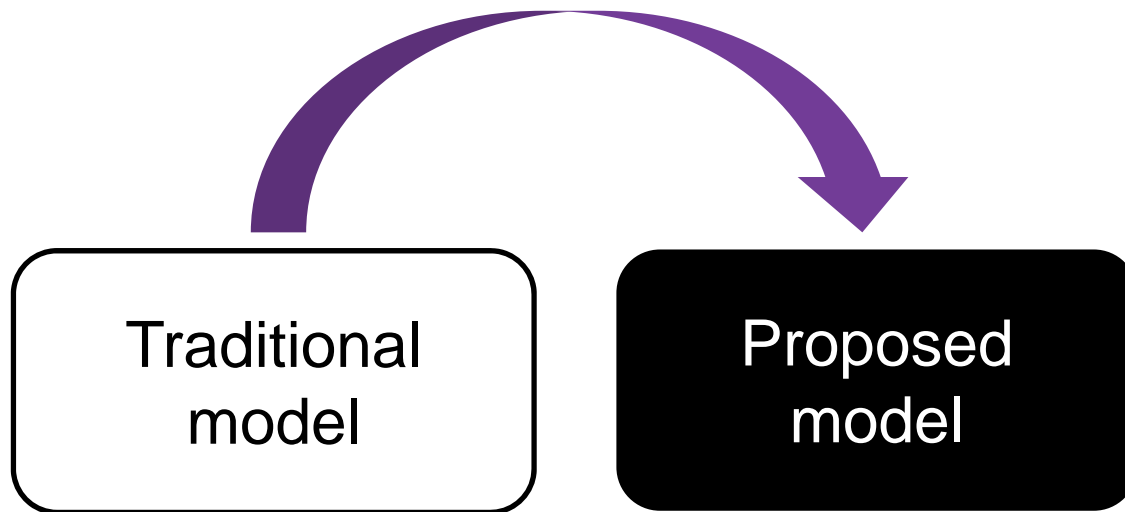
Traditional model



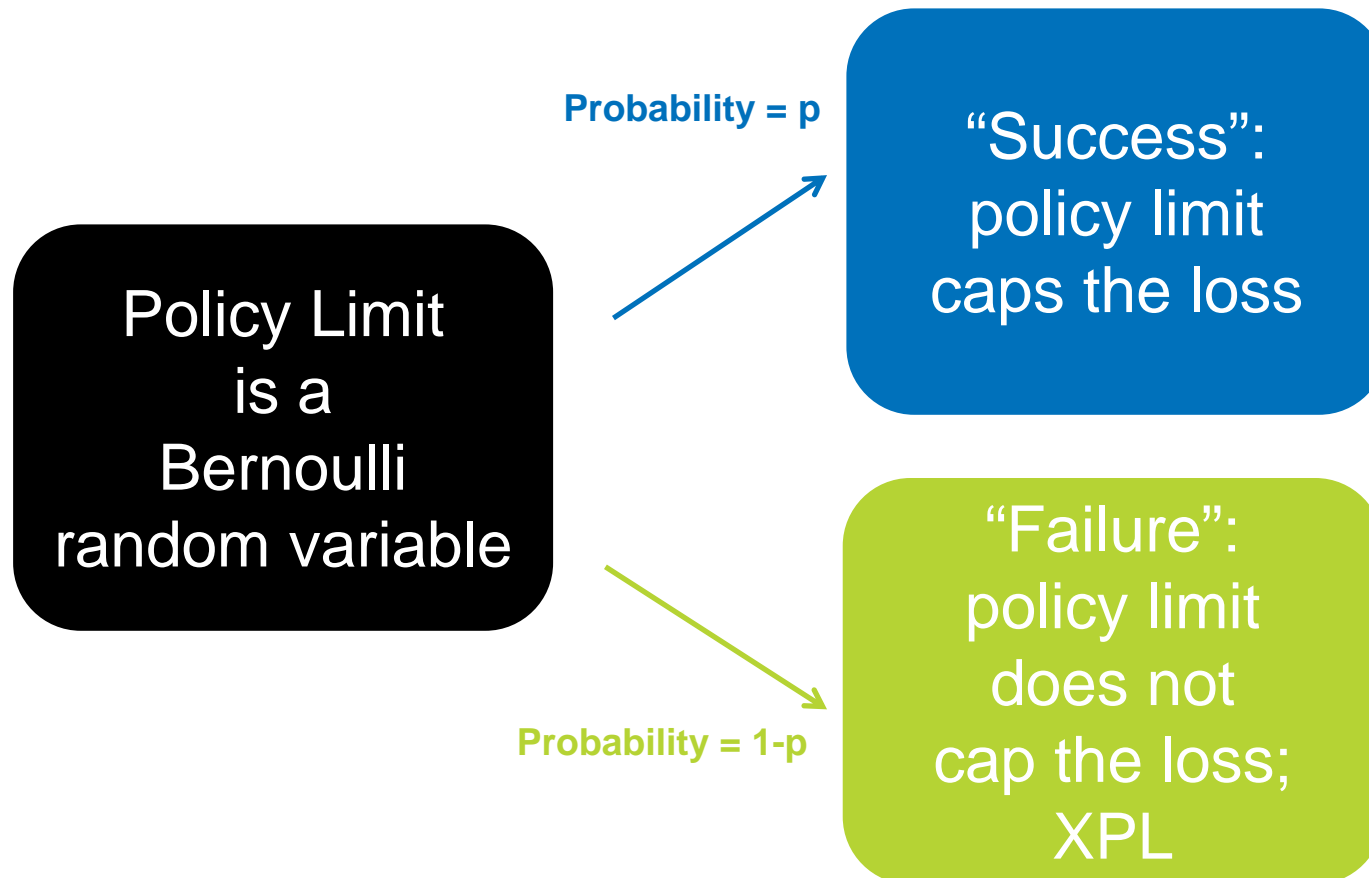
Reinsurance layer

Capping by policy limit suppresses losses from exposing the reinsurance layer

Now, shift your paradigm



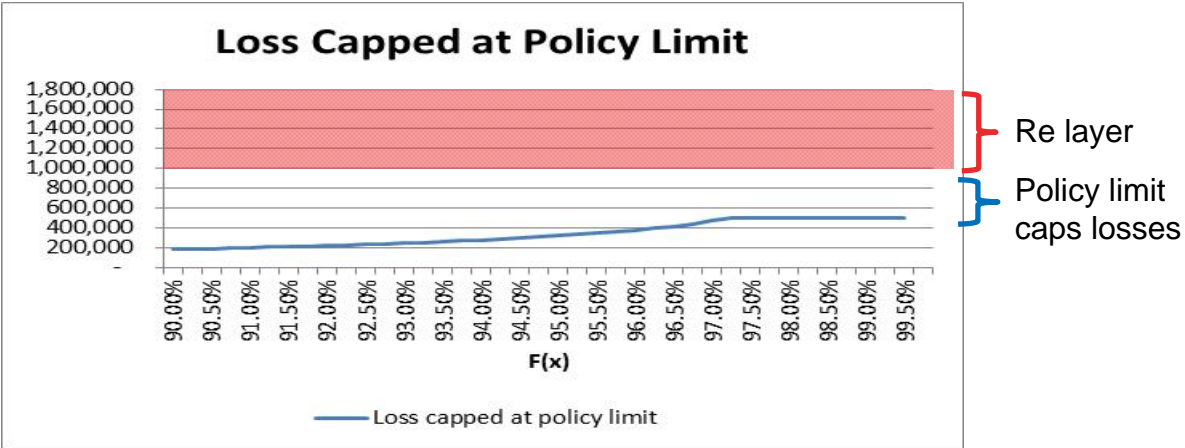
Proposed model



Proposed model

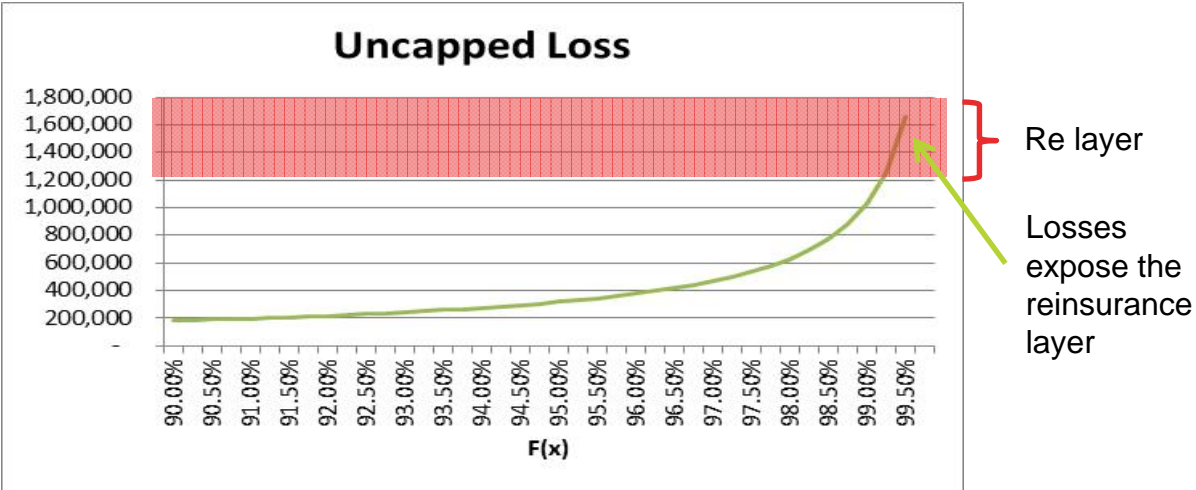
Probability = p

“Success”:
policy limit
caps the loss



Probability = $1-p$

“Failure”:
policy limit
does not
cap the loss;
XPL



ANALYSIS AND DISCUSSION

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Implementation options

- Simulation
- Analytic formula

Simulation

- Suitable for
 - Cat models
 - Economic capital models
- Not suitable for
 - Reinsurance exposure rating
 - Use analytic formula

Reinsurance exposure rating

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- Traditional model
 - Use “exposure factor”
 - % exposure in layer = layer LEV / policy LEV
 - Layer LEV reflects policy limit capping

Traditional model

- Use Limited Expected Value (LEV)

$$LEV(X, k) = \int_0^k xf(x)dx + k[1 - F(x)]$$

Reinsurance exposure rating

- Proposed method:
 - % exposure in layer = layer LEV / policy LEV
 - Layer LEV reflects
 - Probability p :
 - Success
 - Layer LEV if the policy limit caps the loss
 - Probability $1-p$:
 - Failure
 - Layer LEV if the policy limit does not cap loss

Traditional model

- Use Policy Limited Expected Value (PLEV)

$$PLEV(X, k, Z) = p \left\{ \int_0^k xf(x)dx + k[1 - F(x)] \right\} + (1 - p) \left\{ \int_0^{\infty} xf(x)dx \right\}$$

$$PLEV(X, k, Z) = pLEV(X, k) + (1 - p)E[X]$$

NUMERICAL EXAMPLE

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Numerical example

- Severity curve
 - Pareto (2 parameters)
 - Theta = 50,000
 - Alpha = 1.5

Limits Profile		
Limit	% of Premium	ELR
50,000	1.0%	65.0%
100,000	1.0%	65.0%
500,000	2.0%	65.0%
1,000,000	80.0%	65.0%
2,000,000	10.0%	65.0%
3,000,000	1.0%	65.0%
4,000,000	1.0%	65.0%
5,000,000	3.0%	65.0%
10,000,000	1.0%	65.0%

XPL Modeling Parameters		
Amount	Probability of "success" = p	1 - p
50,000	99.0%	1.0%
100,000	99.0%	1.0%
200,000	99.0%	1.0%
300,000	99.0%	1.0%
400,000	99.0%	1.0%
500,000	99.0%	1.0%
600,000	99.0%	1.0%
700,000	99.0%	1.0%
800,000	99.0%	1.0%
900,000	99.0%	1.0%
1,000,000	99.0%	1.0%
2,000,000	99.0%	1.0%
3,000,000	99.0%	1.0%
4,000,000	99.0%	1.0%
5,000,000	99.0%	1.0%
6,000,000	99.0%	1.0%
7,000,000	99.0%	1.0%
8,000,000	99.0%	1.0%
9,000,000	99.0%	1.0%
10,000,000	99.0%	1.0%
25,000,000	100.0%	0.0%

Output

Exposure Rating Output with XPL Loading						
1	2	3	4	5	6	
			Layer Losses as % of total ground up losses Traditional Exposure Rating	Layer Losses as % of total ground up losses Proposed Method Including XPL	Implied Loading for XPL Proposed / Traditional - 1	
Layer	Limit	Attachment				
1	500,000	-	88.420%	88.440%	0.02%	
2	500,000	500,000	10.067%	10.074%	0.07%	
3	1,000,000	1,000,000	1.150%	1.219%	5.99%	
4	3,000,000	2,000,000	0.333%	0.403%	21.06%	
5	5,000,000	5,000,000	0.031%	0.068%	119.37%	
6	15,000,000	10,000,000	0.000%	0.033%	#N/A	
Total	25,000,000	-	100.000%	100.237%	0.24%	

Proposed method generates layer loss cost including XPL

CONCLUSION

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Conclusion

- Treat policy limit as a Bernoulli random variable
 - Suitable for simulation modeling
 - Cat models
 - Economic capital models
 - Suitable for analytic formulas
 - Exposure rating for XOL reinsurance
 - Practical

Questions & comments?

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- Workbook with implemented formulas is available upon request

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