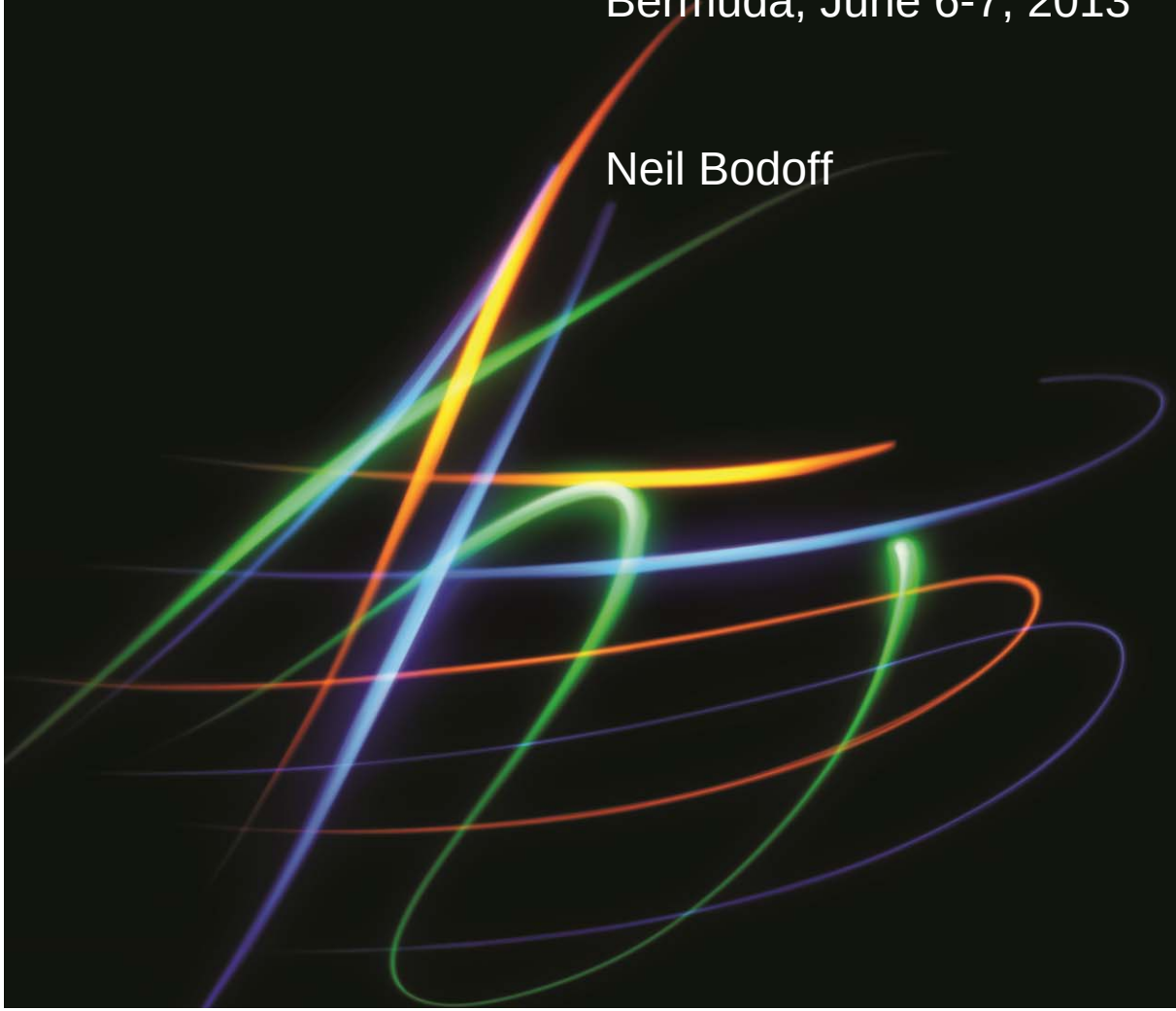
MANAGING EXTREMES Willis Re

AN ACTUARIAL MODEL OF EXCESS OF POLICY LIMITS LOSSES

Seminar on Reinsurance

Bermuda, June 6-7, 2013

Neil Bodoff



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

- 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

- 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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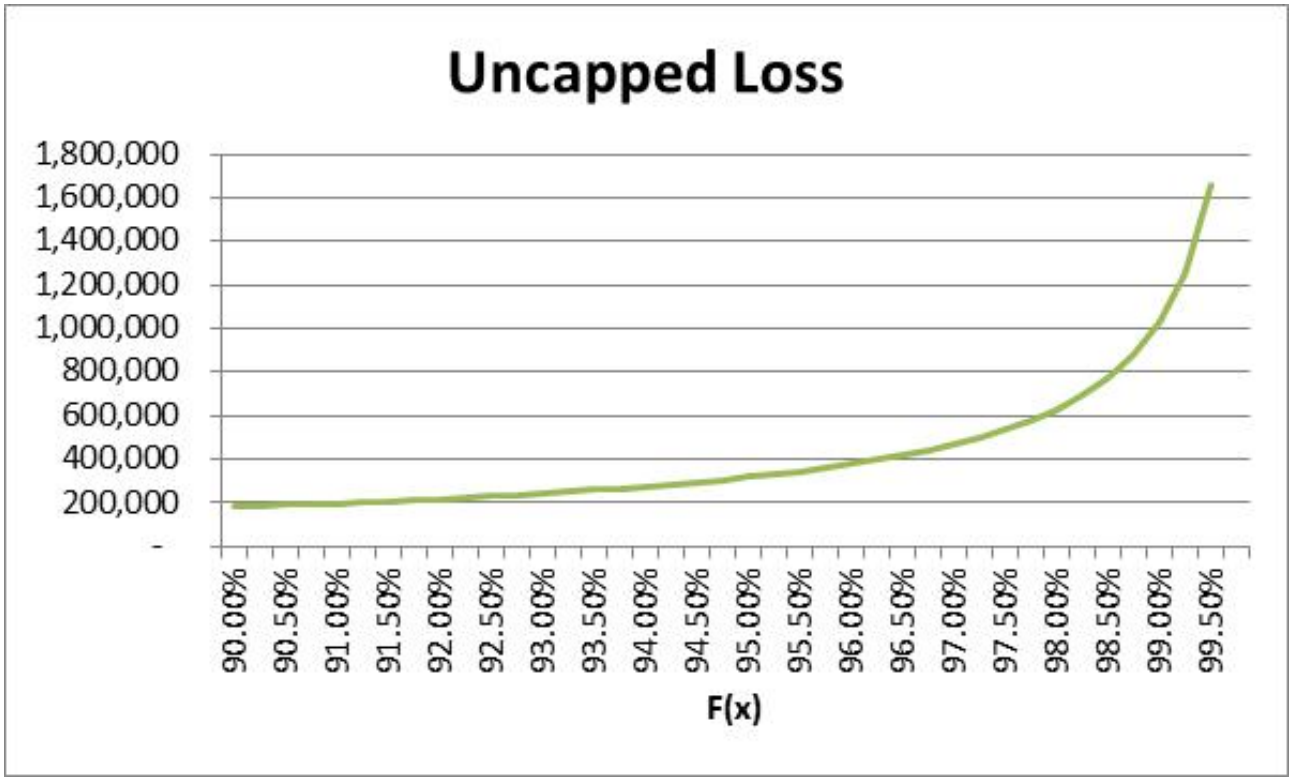
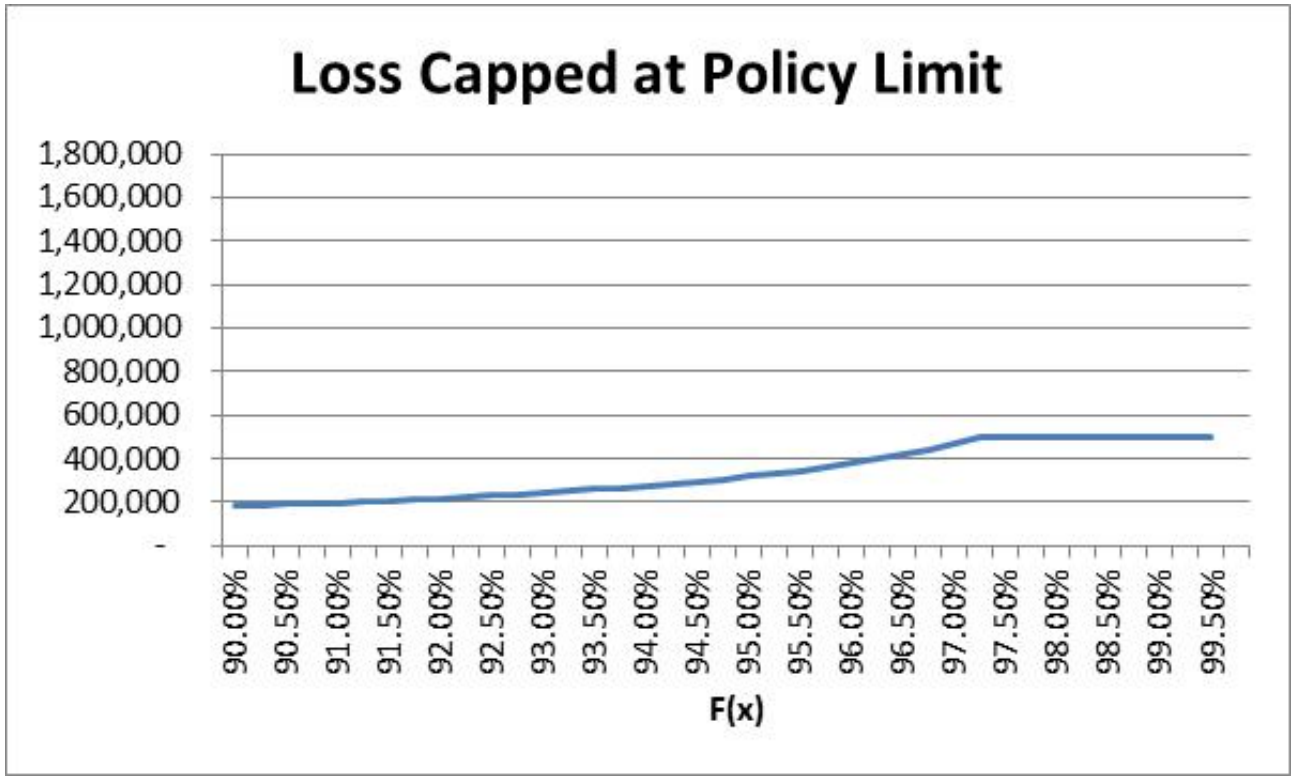
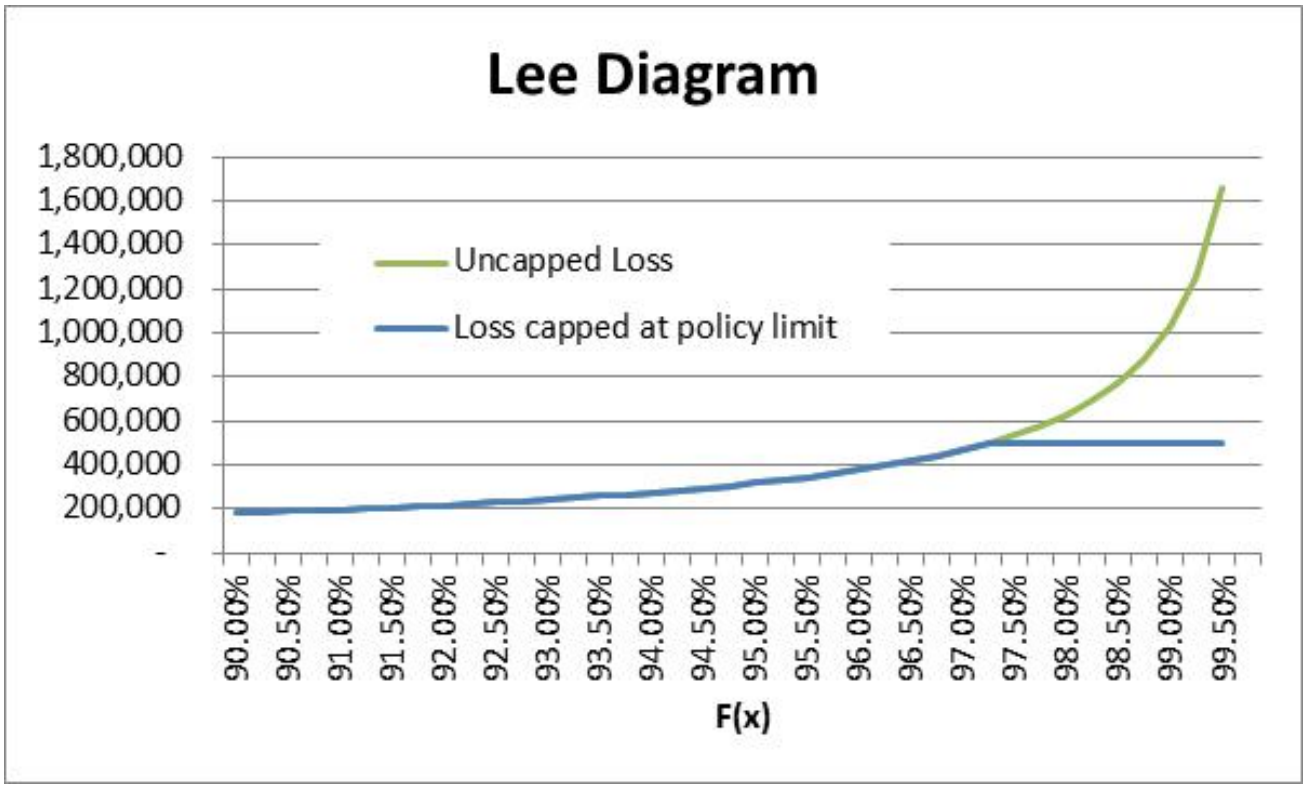
Traditional model



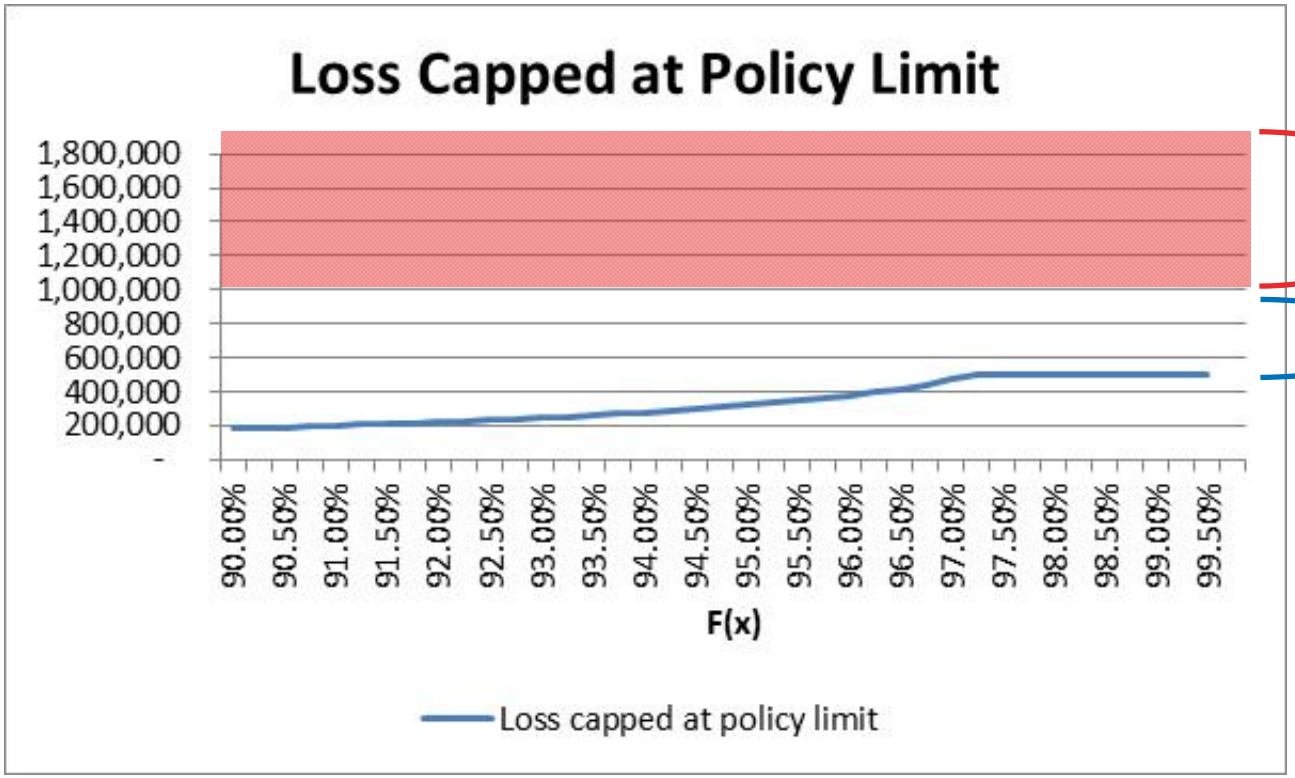
Traditional model



Traditional model



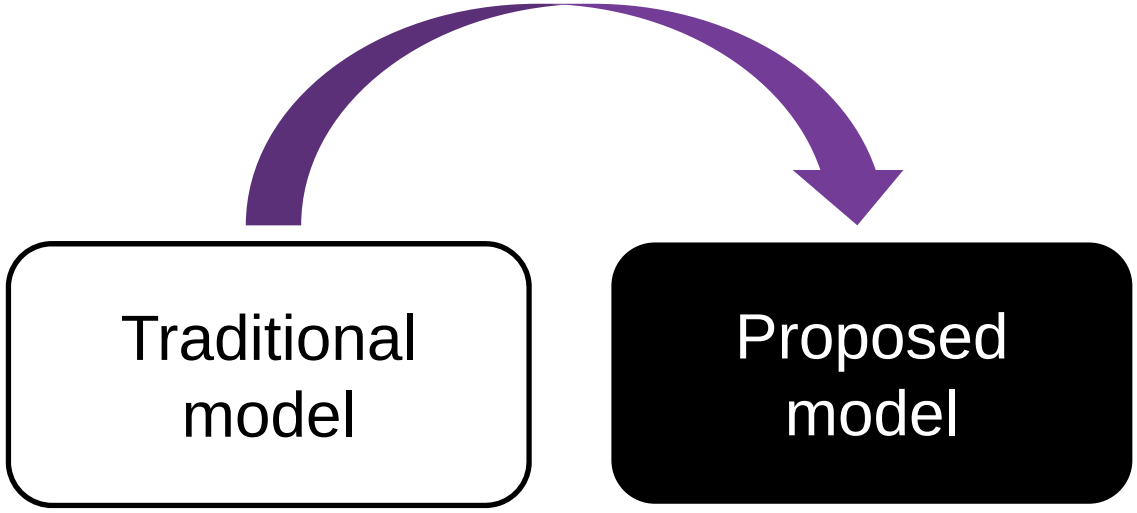
Traditional model



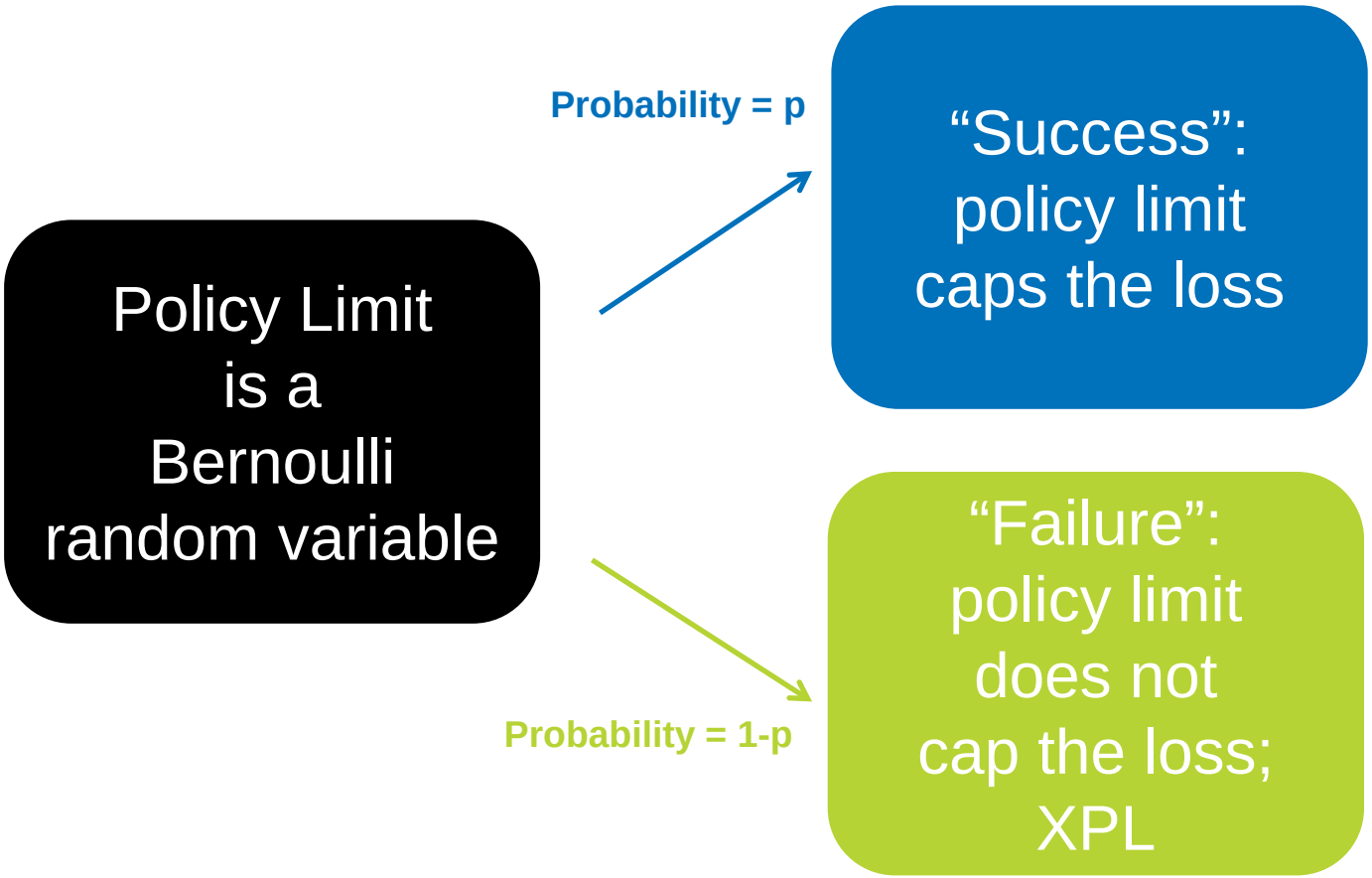
Reinsurance layer

Capping by policy limit suppresses losses from exposing the reinsurance layer

Now, shift your paradigm



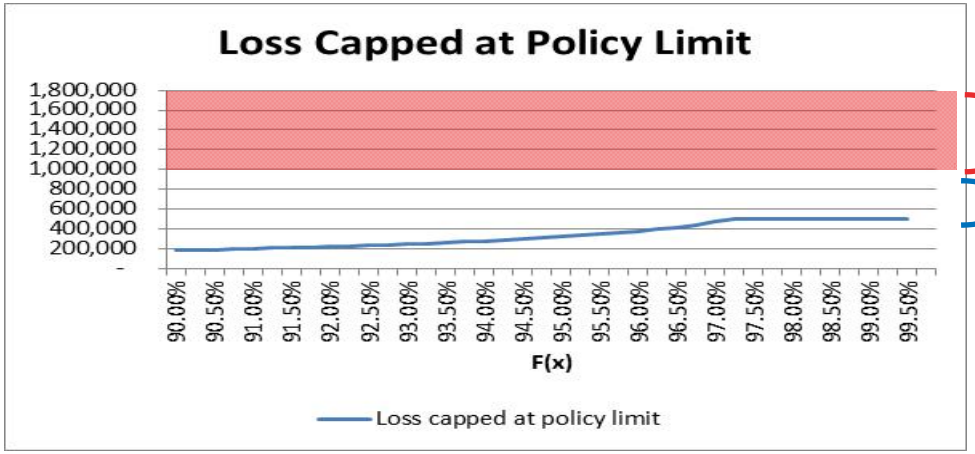
Proposed model



Proposed model

Probability = p

"Success": policy limit caps the loss

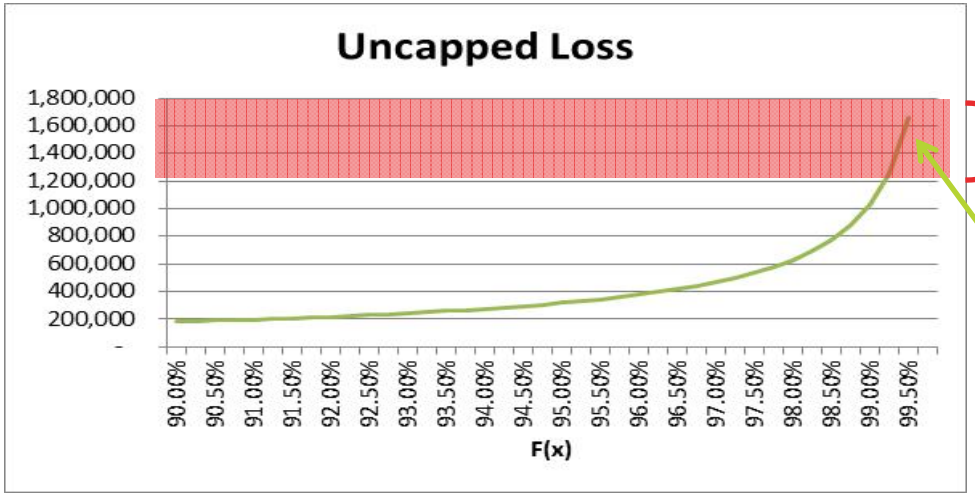


Re layer

Policy limit caps losses

Probability = 1-p

"Failure": policy limit does not cap the loss; XPL



Re layer

Losses expose the reinsurance layer

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

- 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)

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

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

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	Limit	Attachment	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
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?

- Workbook with implemented formulas is available upon request

neil.bodoff@willis.com

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