

# CARe 2009

CS-11: Pricing Property Per Risk  
Advanced Topics

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- Underwriter and actuary
  - Montpelier Re
  - Axis Specialty
- Currently working as a consultant
  - Bermuda Monetary Authority
  - Several other insurance and reinsurance clients

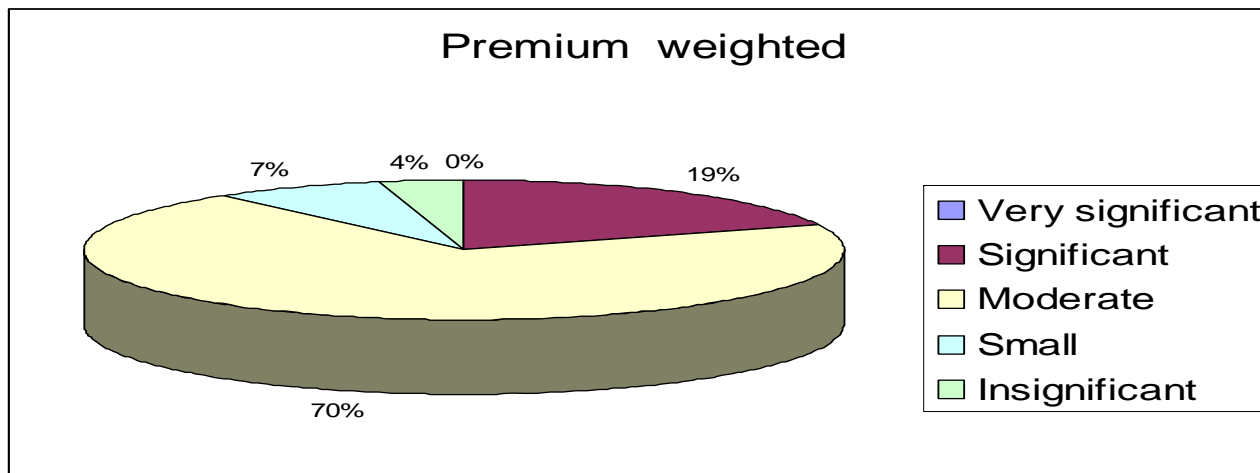
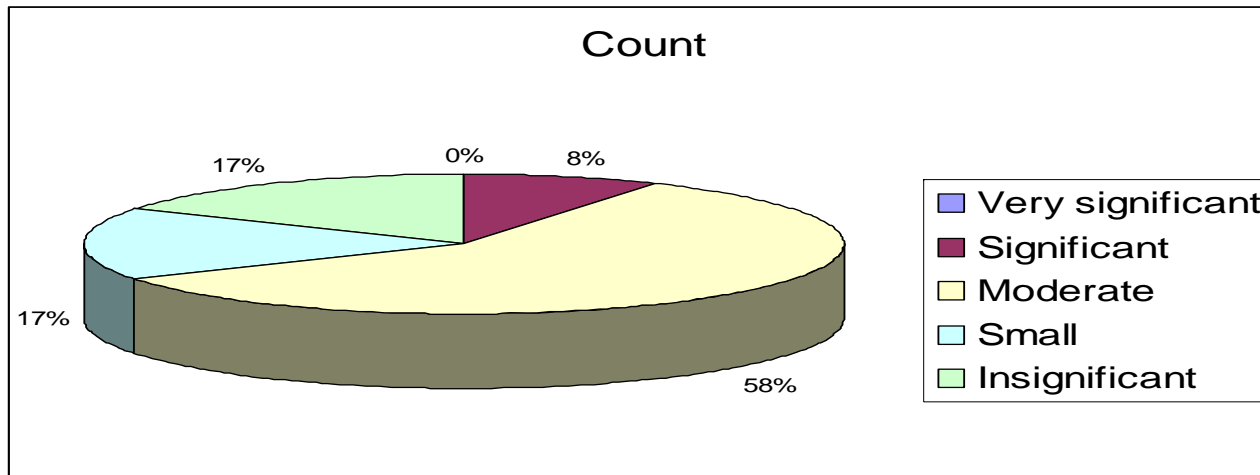
# This presentation

- Cat exposures within per risk treaties
  - Accumulation methodologies
    - Market survey
    - Comments on methodologies employed
    - Detailed examination of bottom up cat accumulation methodology

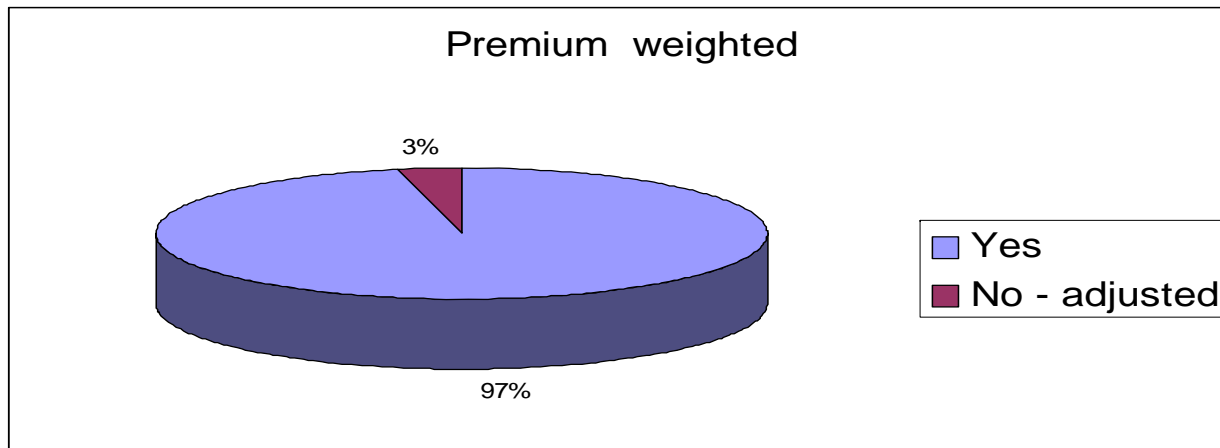
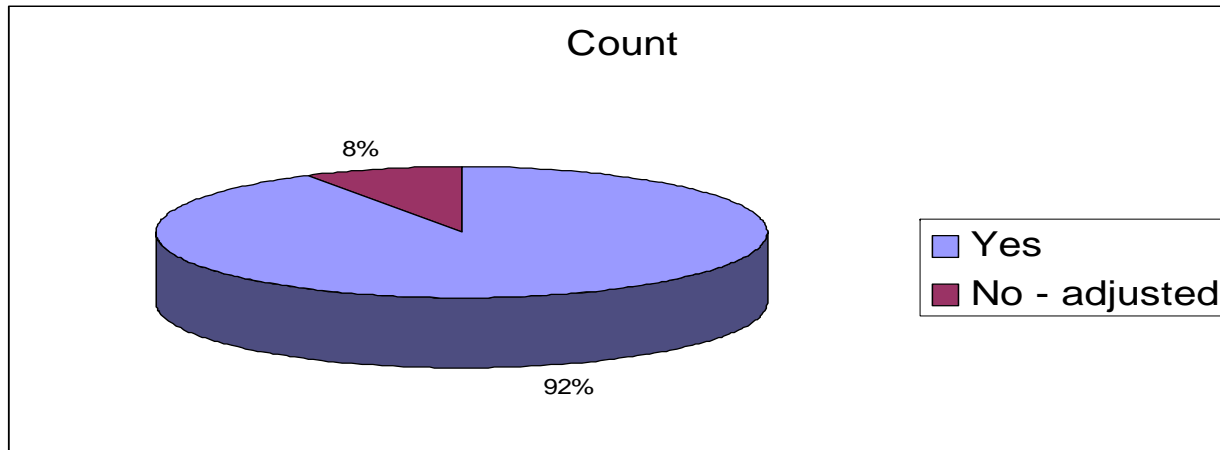
# Market Survey

- 5 questions on consideration of cat exposure within per risk treaties
- 24 respondents – Bermuda, US, UK, Lloyds, Continent
- 2007 NWP of ~ \$22.2B
- Answers presented on an anonymous basis on a count and NWP (P) weighted basis

# Q1 How significant a property per risk writer relative to catastrophe?



Q2 Where detailed data exists is cat model output used to create consistent accumulations with those of the cat book for per risk treaties?

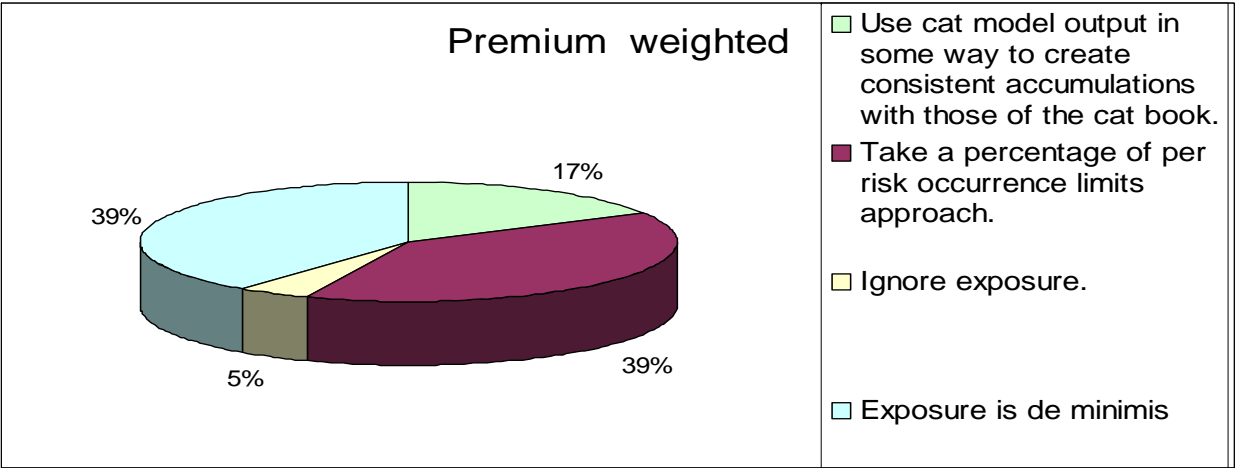
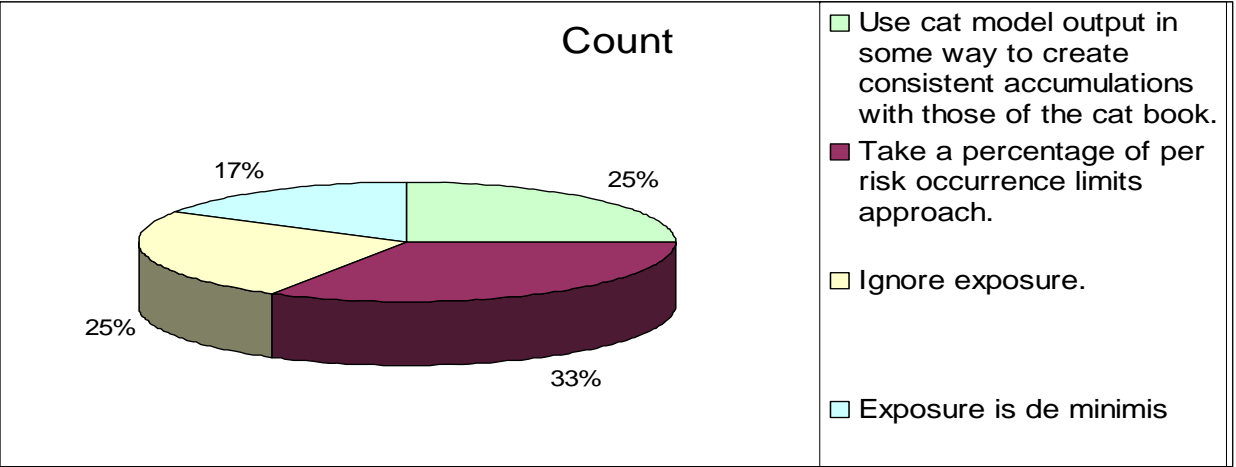


## Q3 Total limits tracked?

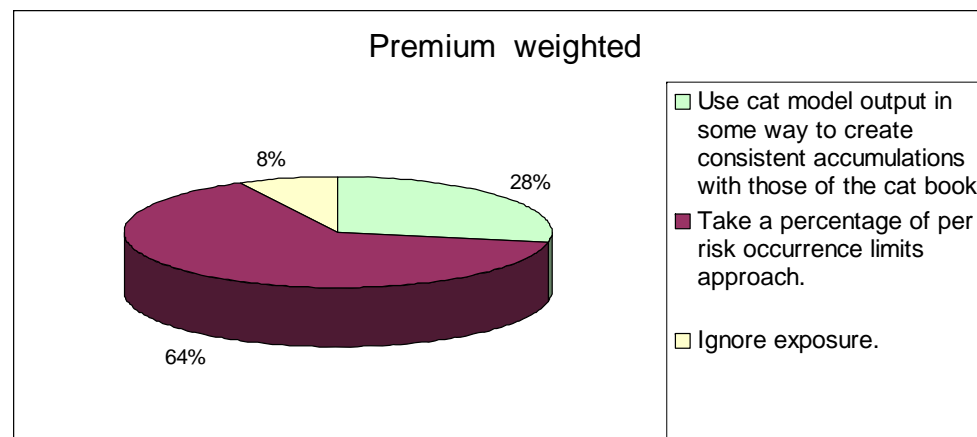
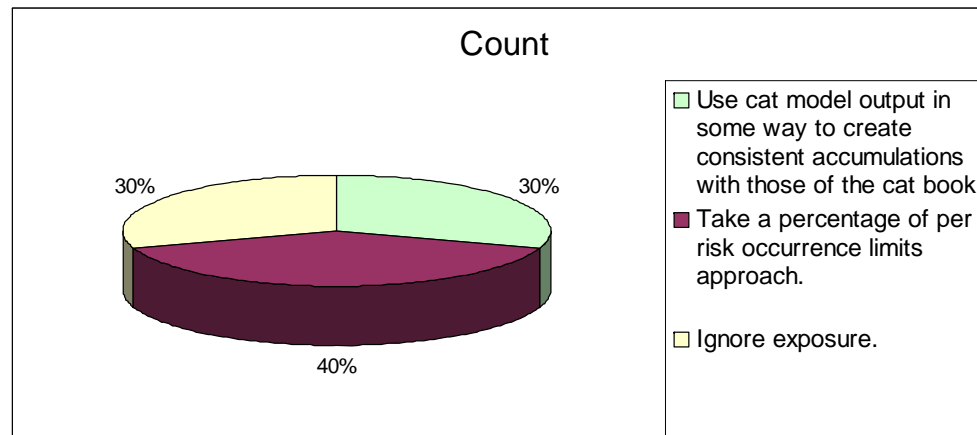
Are you tracking the total limits exposed for both property catastrophe exposures and property per risk exposures?

– 100% yes

# Q4 What do you do when there is no detailed data?



# Q4 No detailed data with non de minimis exposure



# Q5 Other comments from participants

- Some companies are attempting to control clash exposure across treaty and D&F books by questioning treaty clients on what exposures if any they have to biggest D&F exposures.
- One market commented on an international trend to include “reverse” two risk warranties in per risk treaties
  - Pushing the cat into the cat treaty
- Seems as though detailed cat modeling data when received is only provided from one cat model

# When there is no detailed data

- Predominantly a problem outside the US
- Ignore exposure – 8% (P)
- Take a percentage of per risk occurrence limits approach – 64% (P)
- A methodology that uses cat model output somehow to create consistent accumulations with those of the cat book – 28% (P)

# Ignore exposure

- For survey respondents so answering:
  - Moderate writers 84% (P)
  - Insignificant writers 16% (P)
- Understates EP curves to:
  - Board
  - Rating agencies
- Incremental pricing impacted
  - Extent may depend on pricing methodology
  - Per risk natural perils exposure and cat natural perils exposure inconsistently priced?

# Top down versus bottom up

- Both percentage of limits and cat model approaches can be conducted on a top down or bottom up approach
  - Bottom up - For each per risk contract separately
  - Top down - For risk book by subsection or in its entirety
- Both methods and both approaches require explicit assumptions to be made
  - Which approach and assumptions introduce the most uncertainty?

# Percentage of per risk occurrence limits approach

- For survey respondents so answering:
  - Significant 49% (P)
  - Moderate writers 41% (P)
  - Insignificant writers 10% (P)
- Percentages of limits approach varied:
  - Some assume the proportion of cat limits exhausted will be the same for the per risk limits
  - Some apply various percentages of limits lost across the curve
  - “No surprise” approach - apply total limits in the tail

The proportion of cat limits exhausted will be the same for the per risk limits

- Appropriateness depends on extent probability of cat book attaching “mirrors” the probability of the risk book attaching
- Distributions will be different but roughly equivalent to stating:

$$\text{PPROL}_{\text{natural perils}}[\text{cat book}] = \text{PPROL}_{\text{natural perils}}[\text{risk book}]$$

# Various percentages of limits lost across the curve

- For those selecting various percentages the rough average percentages proffered:
  - 15% above 50 year event
  - 30% above 100 year event
  - 50% above 250 year event
  - 75% above 500 year event

# Questions on this approach

- Is the reference return period curve the same as the geographical extent of the per risk contract?
- Is the return period referenced the industry curve or the cedant's cat portfolio curve?
- Are the percentage choices somewhat arbitrary?
- Does the implied loss ratio of these accumulation methodologies equal that assumed in the pricing?

# Bottom up cat model output methodologies

- Determine modelable natural perils cat loss ratio for per risk contract
  - Historical experience analysis
  - Use a per risk exposure curve
  - Underwriter judgment
  - Assumption

# Per risk exposure curve

Risk Limit	Risk Retention	E(L) to layer - Per risk curve GU Loss	Explicit calculation	
			Commercial EQ exposed building	Commercial Hurricane exposed
			E(L) to layer - explicit calc GU Loss	E(L) to layer - explicit calc GU Loss
10,000,000	90,000,000	0.7%	1.7%	1.1%
10,000,000	80,000,000	1.1%	2.1%	1.6%
10,000,000	70,000,000	1.4%	2.6%	2.3%
10,000,000	60,000,000	1.7%	3.4%	3.2%
10,000,000	50,000,000	2.3%	4.4%	4.3%
10,000,000	40,000,000	3.0%	6.0%	5.9%
10,000,000	30,000,000	4.2%	8.5%	8.2%
10,000,000	20,000,000	6.4%	12.5%	11.9%
10,000,000	10,000,000	11.8%	19.8%	18.7%
10,000,000	-	67.3%	39.0%	42.8%
100,000,000	-	100.0%	100.0%	100.0%

Clear that both hurricane and earthquake have greater propensity to cause loss to higher layers

- Supports the argument of using cat models to determine loss likelihood rather than using a per risk exposure curve.

# Simple example

- Insurance company purchases following program:
  - Cat \$10M x \$10M
  - Per risk \$5M x \$5M
    - Occurrence limit of \$10M
- Use cat vector from cat program with scalar multiples applied to solve for the selected per risk losses

# Simple example 2

	Perspective	Cat
	Occurrence Limit	10,000,000
	Occurrence Retention	10,000,000
	Risk Limit	
	Risk Retention	
Calculated E(L)	8,240,000	2,000,000
Loss #	Ground up	Loss to layer
1	<b>17,000,000</b>	<b>7,000,000</b>
2	3,000,000	-
3	800,000	-
4	11,000,000	1,000,000
5	13,000,000	3,000,000
6	1,600,000	-
7	5,000,000	-
8	2,000,000	-
9	<b>18,000,000</b>	<b>8,000,000</b>
10	11,000,000	1,000,000

	Perspective	Risk
	Occurrence Limit	10,000,000
	Occurrence Retention	
	Risk Limit	5,000,000
	Risk Retention	5,000,000
	Selected E(L)	<b>500,000</b>
	Calculated E(L)	500,000
Scale factor	<b>30%</b>	
Loss #	Ground up Scaled	Loss to layer
1	<b>5,100,000</b>	<b>100,000</b>
2	900,000	-
3	240,000	-
4	3,300,000	-
5	3,900,000	-
6	480,000	-
7	1,500,000	-
8	600,000	-
9	<b>5,400,000</b>	<b>400,000</b>
10	3,300,000	-

# Assumptions

- Assumes the geographical concentrations of risks protected by a per risk treaty are identical to the general geographical concentration of the entire portfolio
  - E.g. a company writing residential, small commercial and heavy industrial business
- Assumes the gradient/shape of the cat curve is identical for the per risk curve

# Problems

- Some events in theory might never be able to cause a loss to the risk program
  - However this is not “knowable”
    - Detailed data is by definition not available
  - Or
  - Cat model does not perform detailed calculations for this region

# Refinements

- Use industry cat curve
- Use cedant cat curve
- Use premium by territory for per risk exposure to create a better mix of likely exposure to cat loss

# Other advantages

- Use methodology when there is an explicit per risk cat curve but don't believe the model
  - 3% (P)
- Arguably the more 'granular' approach of a bottom up methodology creates a better view of the accumulation risk
- Consistently considers per risk with cat exposure
  - Accumulations
  - Incremental pricing

# Comparison of methodologies

- Data shown is a reinsurers data with methodologies from market survey applied
- Permission provided for presentation on the basis that ratios are shown rather than actual amounts
  - Some ratios “non-ideal” though remain illustrative
- Some “reasonable” assumptions were made in interpreting the survey results
  - E.g. Assumed total limits in tail were for the region-peril exposed

# Summary statistics book under consideration

	Total premium	Total occurrence limits	Maximum region-peril exposed limit	Expected cat loss
Per Risk	20%	19%	26%	7%
Property Cat	80%	81%	74%	93%
Total	100%	100%	100%	100%

*In all the following slides the cat book has be modeled by cat models*

Results depend **highly** on:

- The relative attachment points of the per risk and cat books
- The relative limits profiles of the per risk and cat books
- The relative geographical allocations of the per risk and cat books
- The loss ratios selected on per risk business

# Before we begin

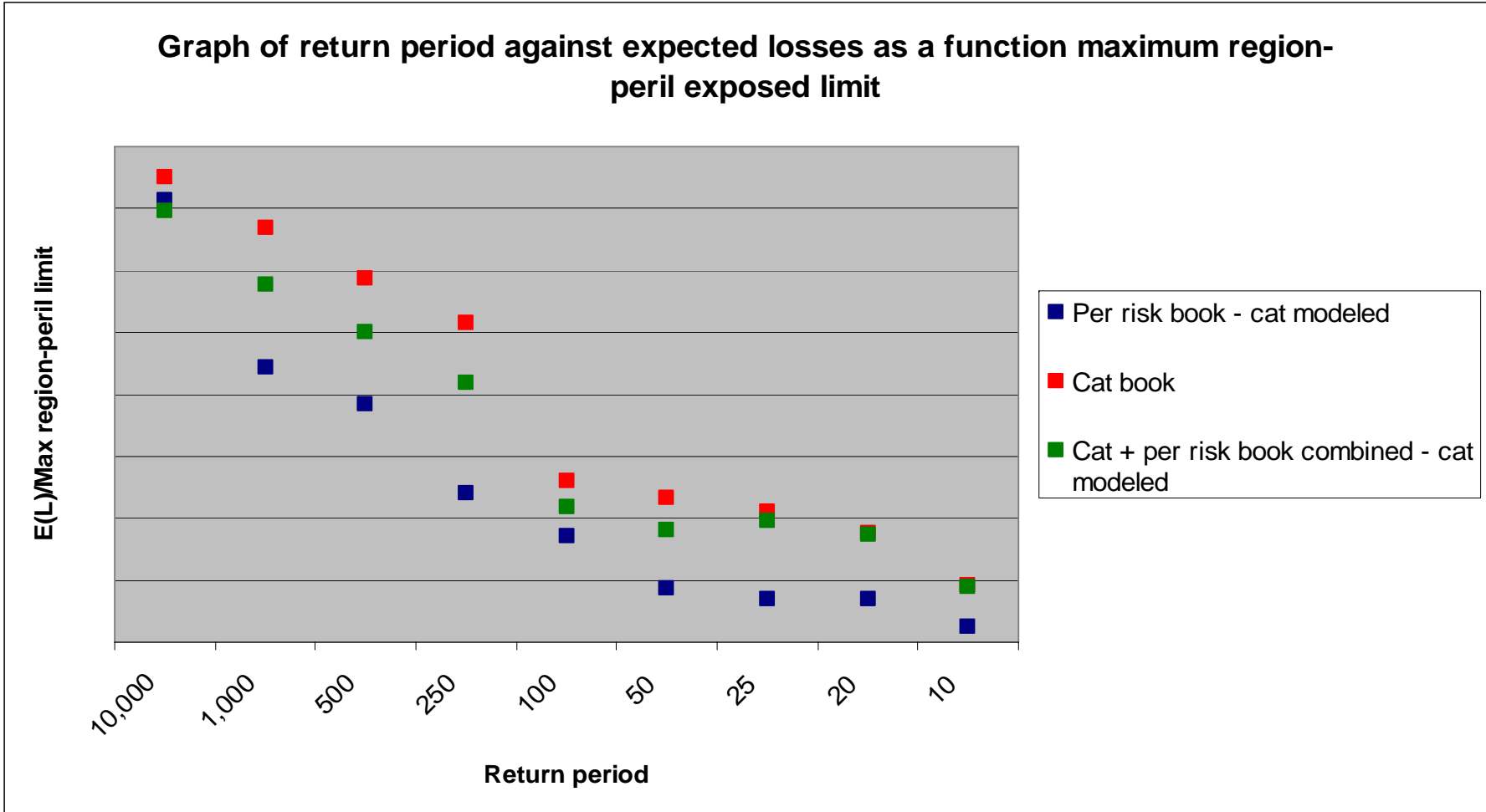
For the 4 methods under consideration have a think about the relative:

- E(LR) for risk book
- Impact on 1 in 100 year event for portfolio
- Impact on 1 in 250 year event for portfolio

## Methods:

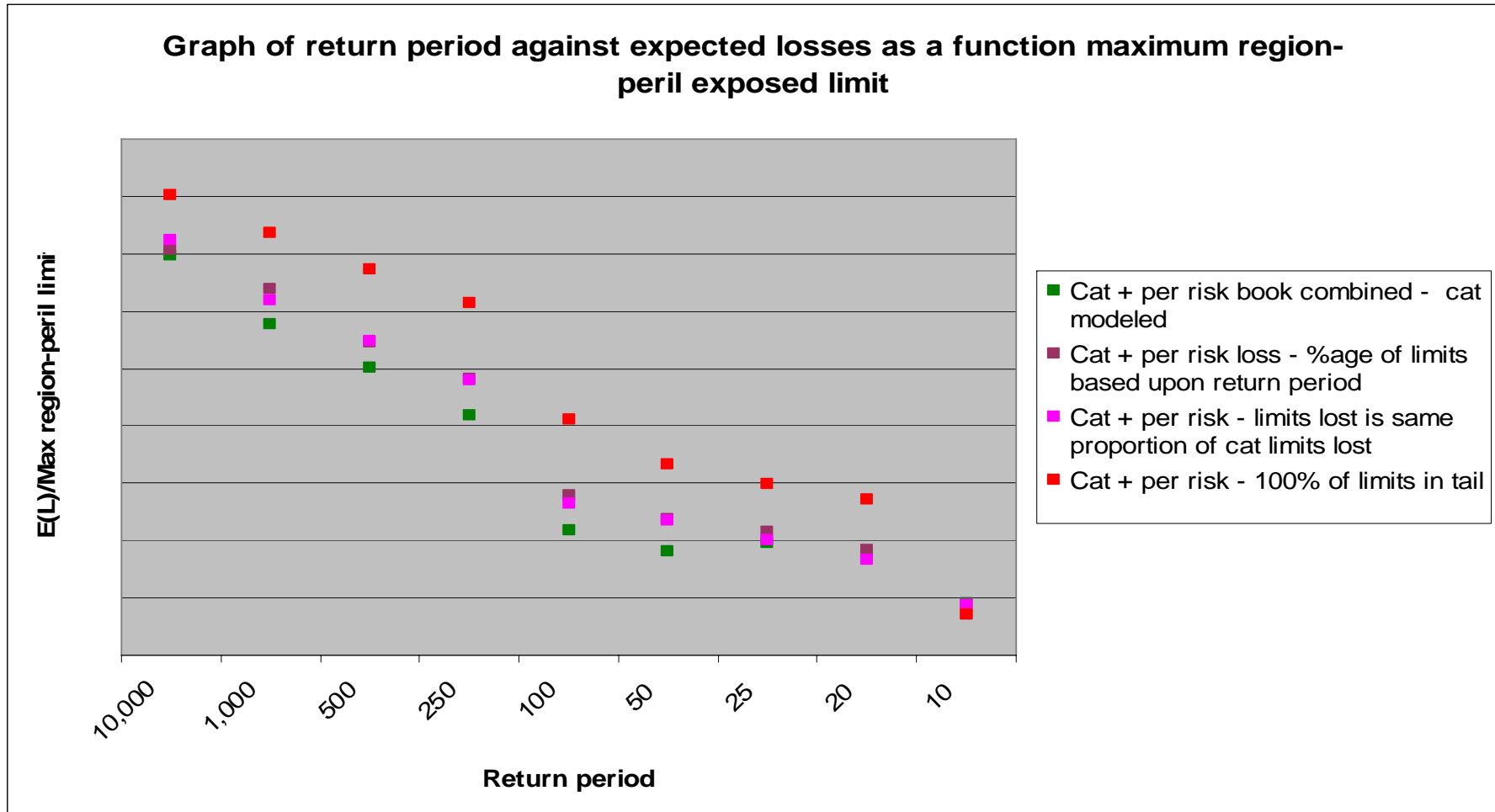
- Use of cat model curve solving to a selected natural perils loss ratio
- Various percentages in the tail
  - 15% above 50 year event
  - 30% above 100 year event
  - 50% above 250 year event
  - 75% above 500 year event
- Proportion of per risk limits exhausted is the same for the per risk limits
- 100% of region-peril limits exhausted above or equal to the 1 in 100 year event for the region-peril

# Portfolio results



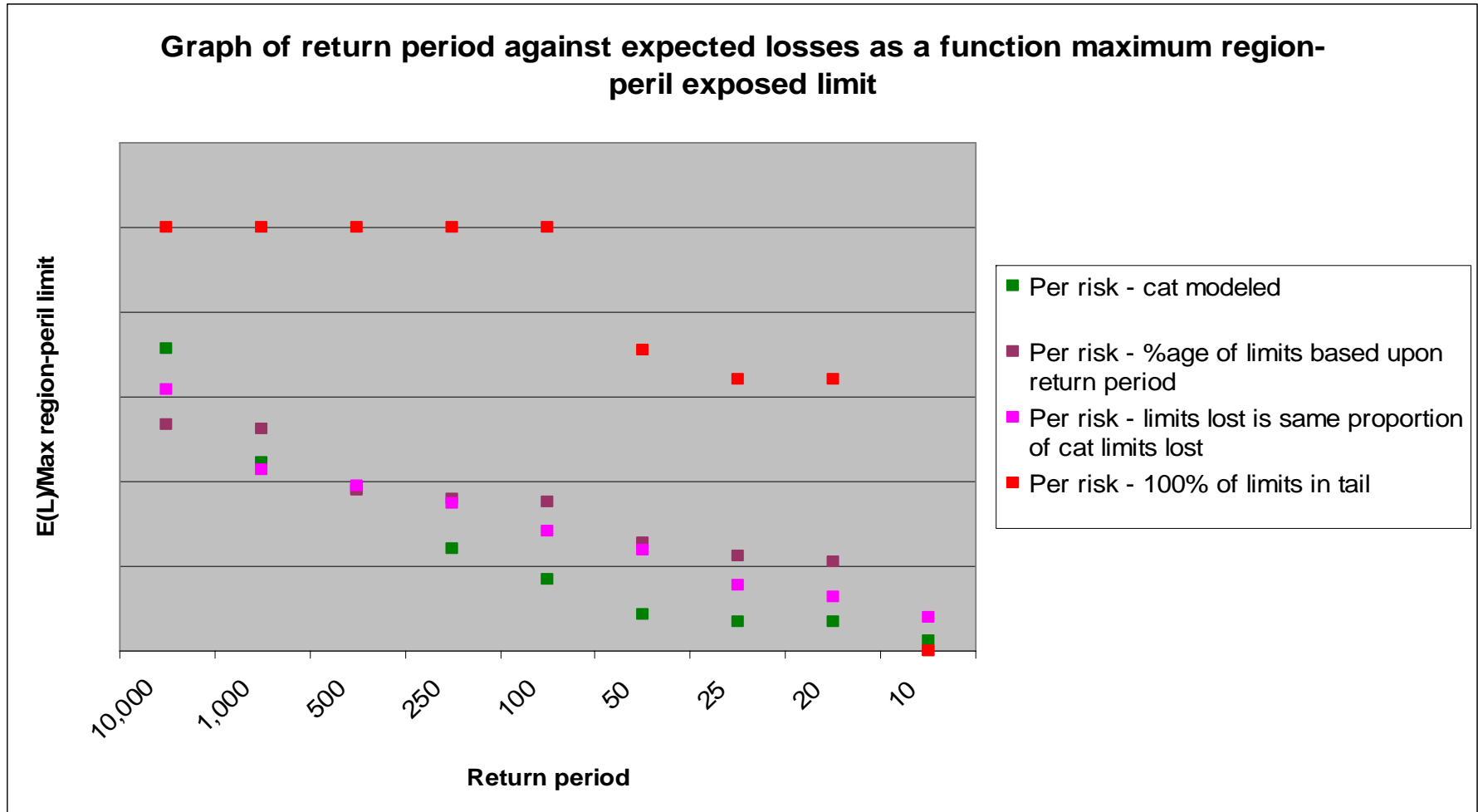
*Cat book has be modeled by cat models*

# Comparison of methods – cat and per risk books combined



*Cat book has be modeled by cat models*

# Comparison of methods – per risk book only



# Other comparative metrics

## Per risk book only

Method	$E(LR)_{natural\ perils}$	Relative TVAR - 100 contribution
Per risk - cat modeled	100%	100%
Per risk loss is a %age of limits based upon RP	184%	141%
Per risk limits lost is same proportion of cat limits lost	252%	130%
Per risk loss is a 100% of limits in tail	584%	372%

## Cat and per risk book combined

Method	1 in 100 year event	1 in 250 year event
Cat + per risk - cat modeled	100%	100%
Cat + per risk loss is a %age of limits based upon RP	128%	115%
Cat + per risk limits lost is same proportion of cat limits lost	122%	115%
Cat + per risk loss is a 100% of limits in tail	190%	147%

# Concluding thoughts

- Clear that the percentage of limits approach excessively penal compared to actual cat model approach
- Perhaps a “conservative” approach
  - Though are:
    - BOD's
    - Rating agencies
    - Regulators
  - All seeing an integrated view of cat + per risk?
- Conservative approaches can be applied to cat model curve methodology by:
  - Selecting the company/industry cat curves over cedants cat curve
    - => greater correlation
  - Increasing selected loss ratios

Questions:

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