Institute and Faculty of Actuaries

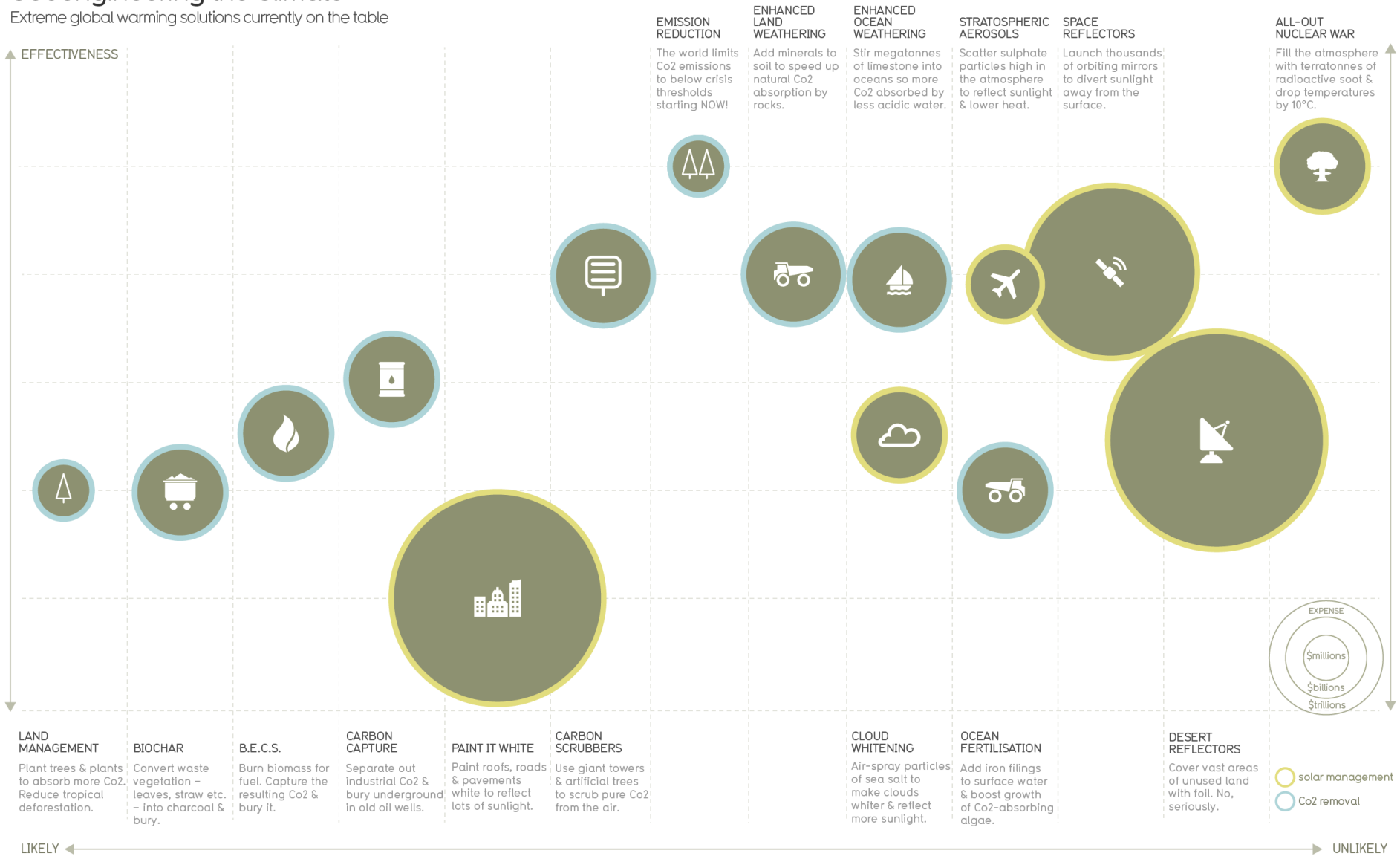
Capital Plenary 2: Communicating Models Effectively (including limitations and appropriate use)

Nasir Shah FIA
Wendy Kriz FIA

26 April 2019

Geoengineering the Climate

Extreme global warming solutions currently on the table



design & concept: David McCandless
research: Miriam Quick
version: 1.5 - Feb 2015

InformationisBeautiful.net
from the new book Knowledge is Beautiful bit.ly/KIB_books

source: Carbon Tracker, Royal Society: "Geoengineering the Climate" (2009)
data: bit.ly/KIB_ClimateFixes

Agenda

- Background to the “problem”
- Why do we need to use visualisation
- What is a “good visual’?
- Examples from other fields
- Use in capital modelling?
- Challenges to overcome
- Questions?

Background

Communication of complex and technical work remains a challenge.

Challenges arise across all communication groups

Upwards to senior management

Our peers

Regulators

Other related users of model output

Actuaries working on their own models

Many mediums available for communicating

Written

Spoken

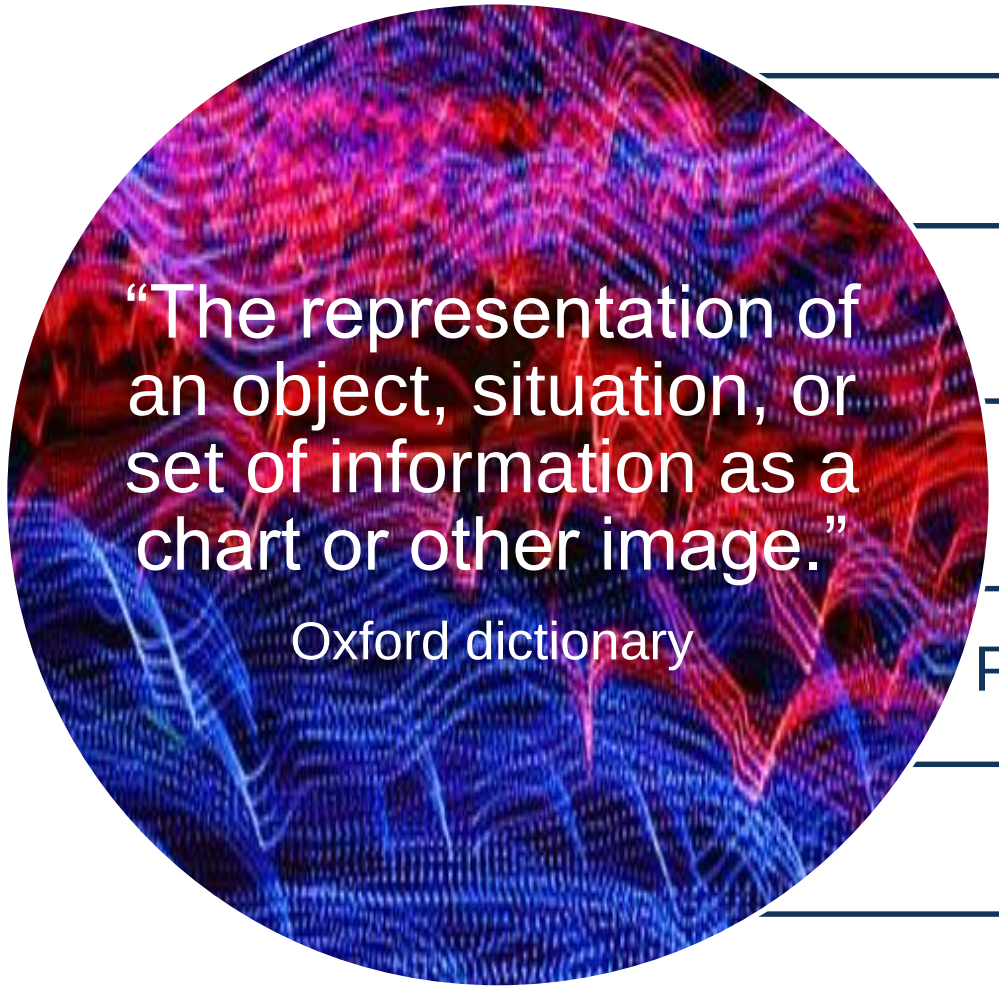
Body language

Visual

How can we begin to overcome such challenges?

Image source: https://www.pexels.com/

What is visualisation?



"The representation of an object, situation, or set of information as a chart or other image."

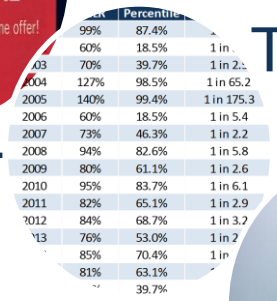
Oxford dictionary

Chart

Picture

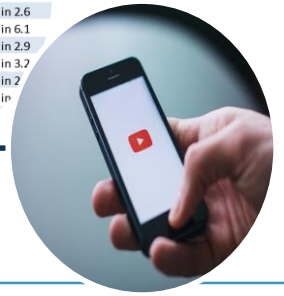
Symbol

Poster



	99%	87.4%	
	60%	18.5%	1 in
03	70%	39.7%	1 in 2.
004	127%	98.5%	1 in 65.2
2005	140%	99.4%	1 in 175.3
2006	60%	18.5%	1 in 5.4
2007	73%	46.3%	1 in 2.2
2008	94%	82.6%	1 in 5.8
2009	80%	61.1%	1 in 2.6
2010	95%	83.7%	1 in 6.1
2011	82%	65.1%	1 in 2.9
2012	84%	68.7%	1 in 3.2
13	76%	53.0%	1 in 2
	85%	70.4%	1 in
	81%	63.1%	
		39.7%	

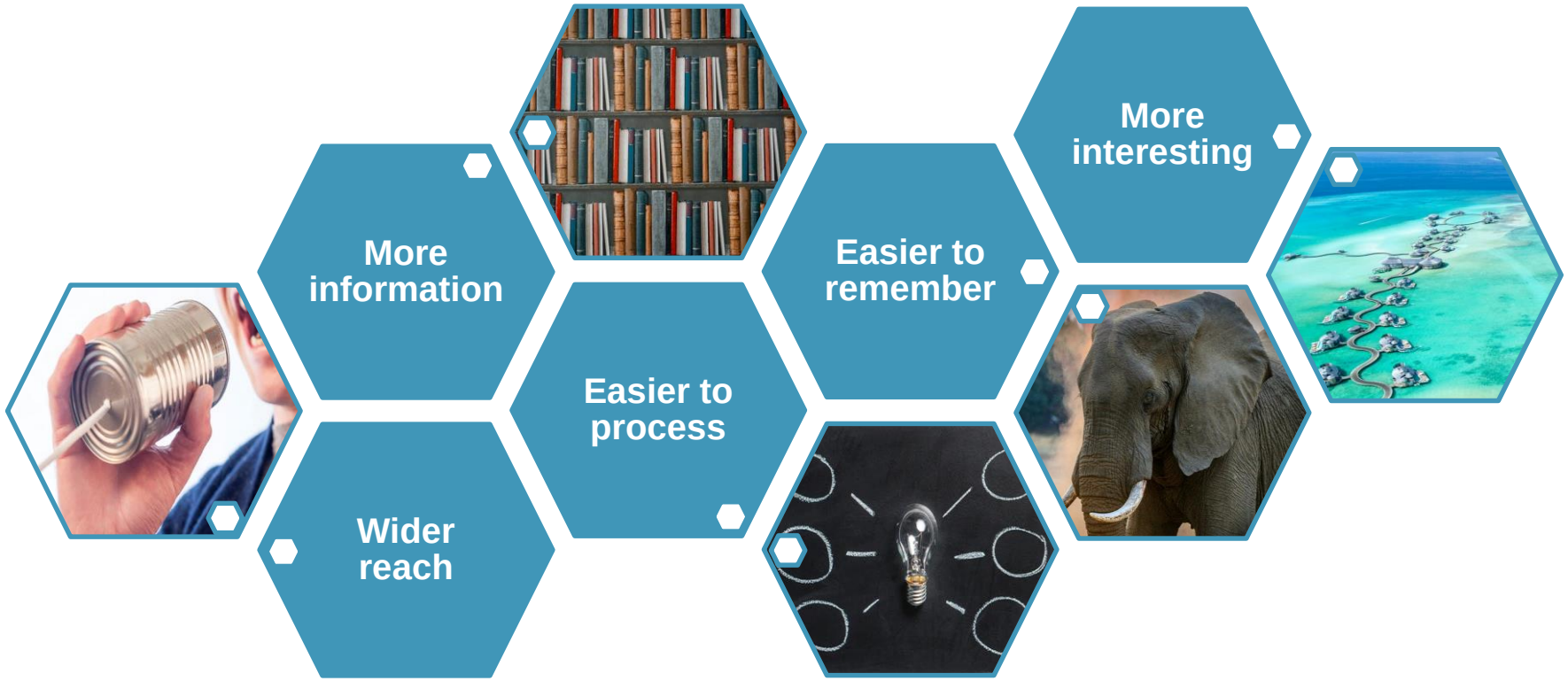
Table



Video

Image source: https://www.pexels.com/

Why do we need visualisation?



"…a single diagram could distil and coalesce a **subject into one image**…When I look at data I feel there is a **story** there, and I want to unveil it…see things in a different light…**can open up new patterns**…"

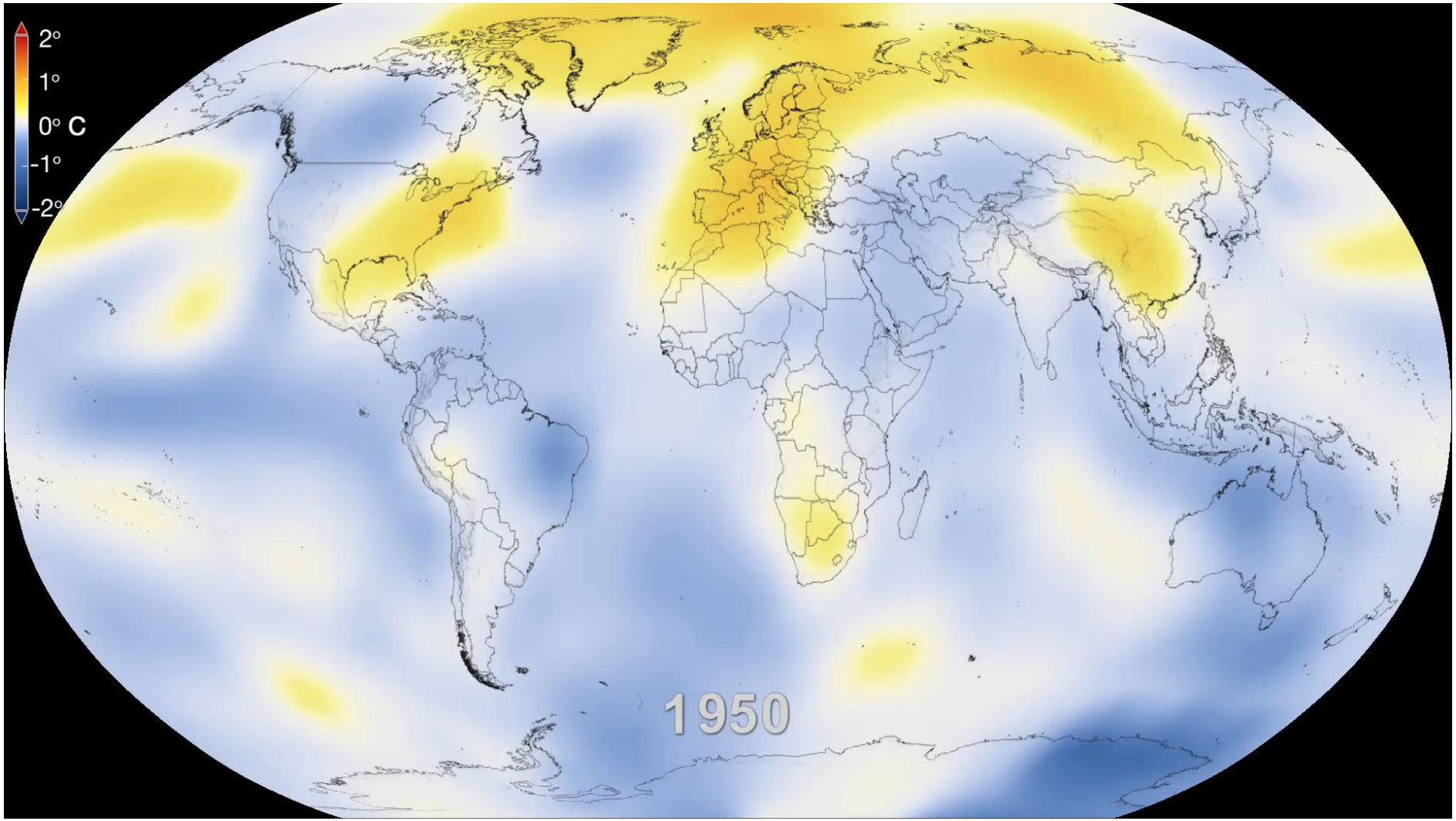
David McCandless, Information is Beautiful

Image source: https://www.pexels.com/

What is a “good visual”?

Image source: https://www.pexels.com/

Examples from wider fields: Climate History



This slide is a moving gif which shows how the global climate has changed from 1950 to 2013

Source: https://climate.nasa.gov/climate_resources/101/video-global-temperature-variation/

Why focus on capital modelling?

Capital modelling

Significant amounts of **data**

Relatively **complex** modelling

Many variables across the whole insurance **company**

Lots of **stakeholders** (including validation and calibration)

Image source: https://www.pexels.com/

Use in capital modelling?

- Risk ranking
- Risk and reward
- Correlations
- Back testing
- Model fitting
- Model stability
- …
- Change analysis
- Granular risk ranking
- Profit and loss attribution
- …

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Risk ranking

Contribution to capital

Risk Category	1 in 200
Premium Risk	51.1%
Reserve Risk	23.0%
Credit Risk	13.4%
Market Risk	7.0%
Op Risk	5.5%

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Risk ranking

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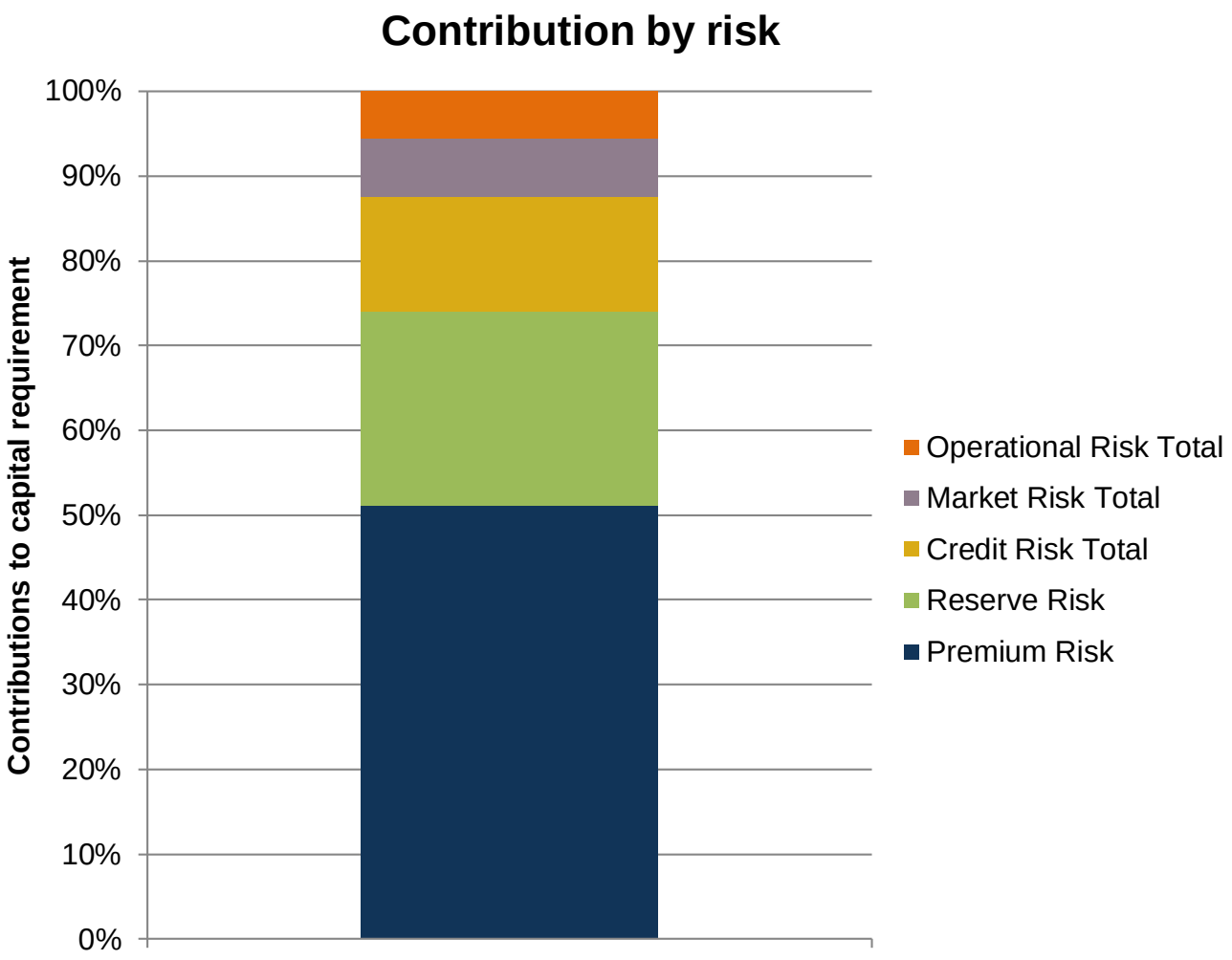
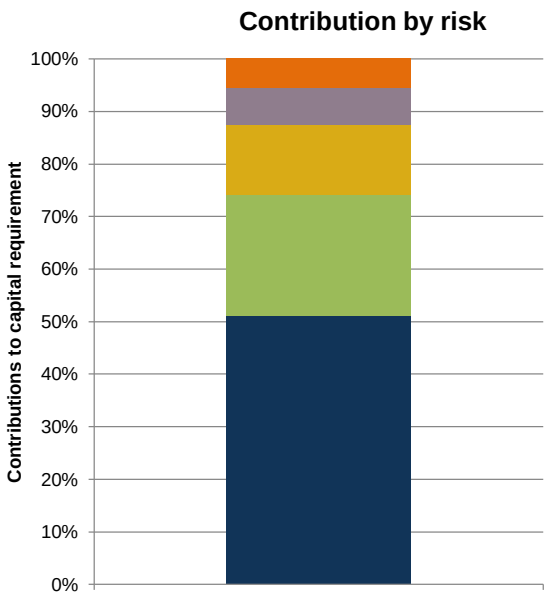
Vs

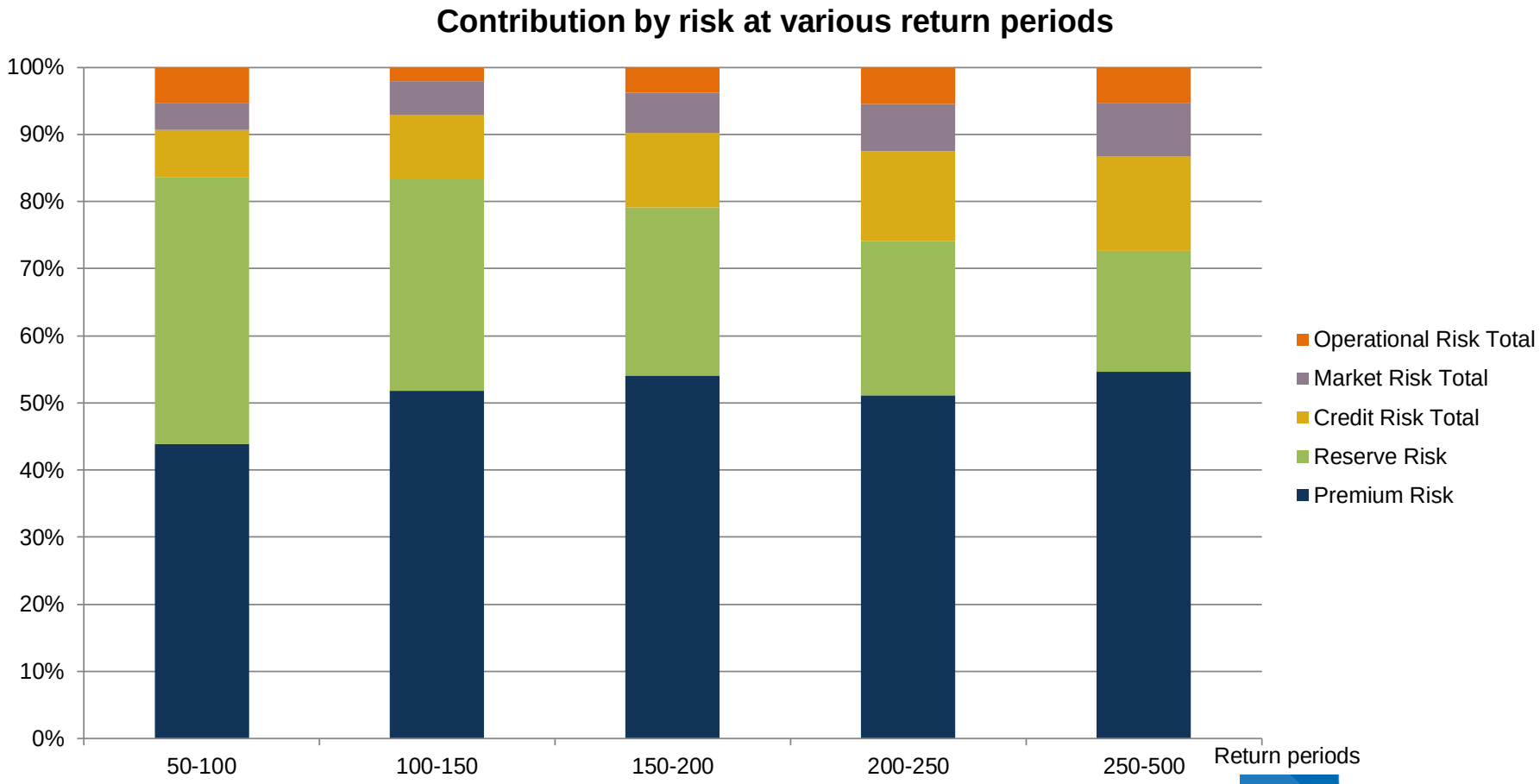


Risk ranking

Contribution to capital

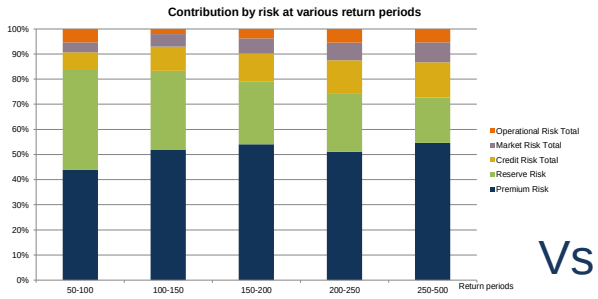


Vs

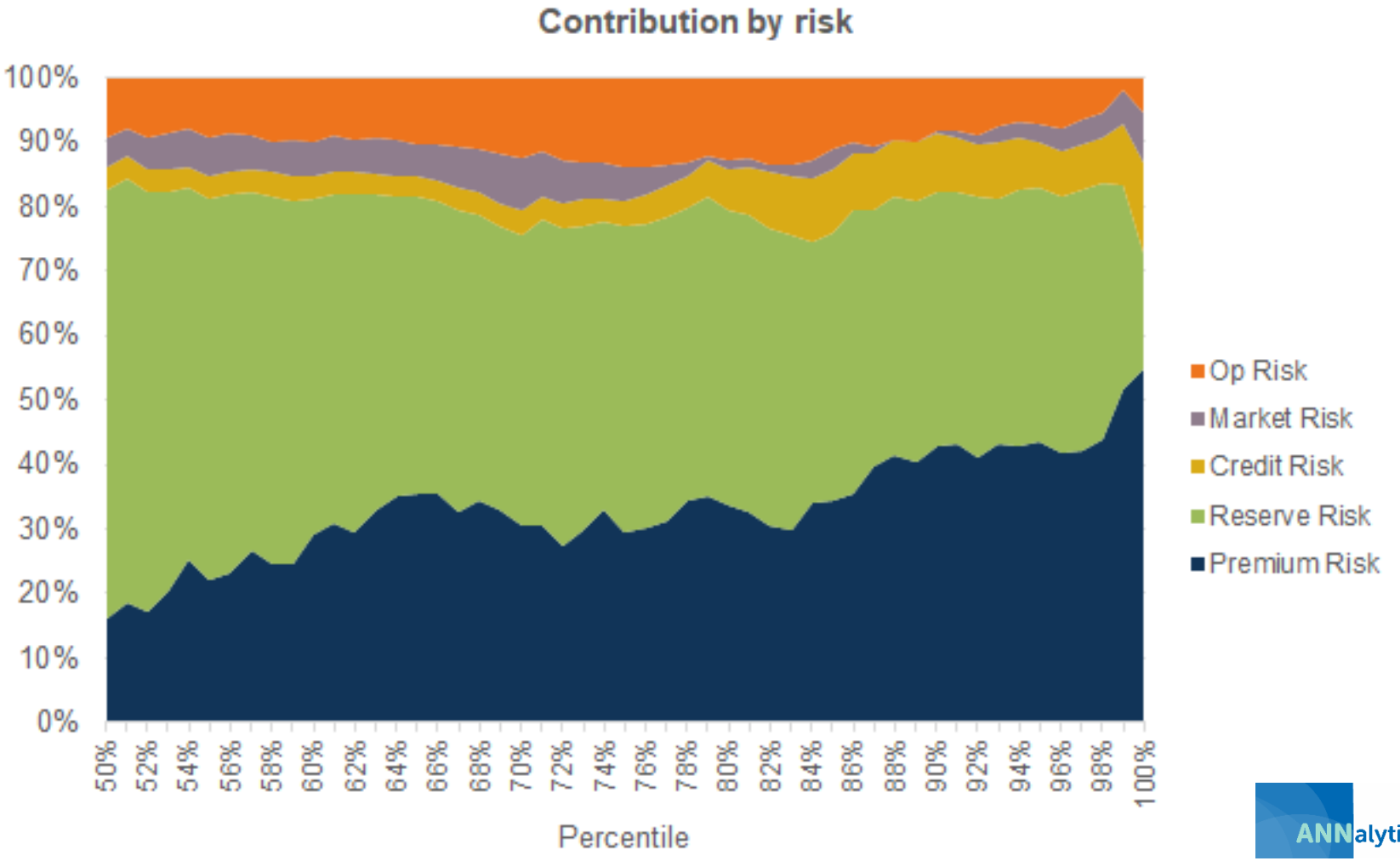


Risk ranking

Contribution to capital



Vs



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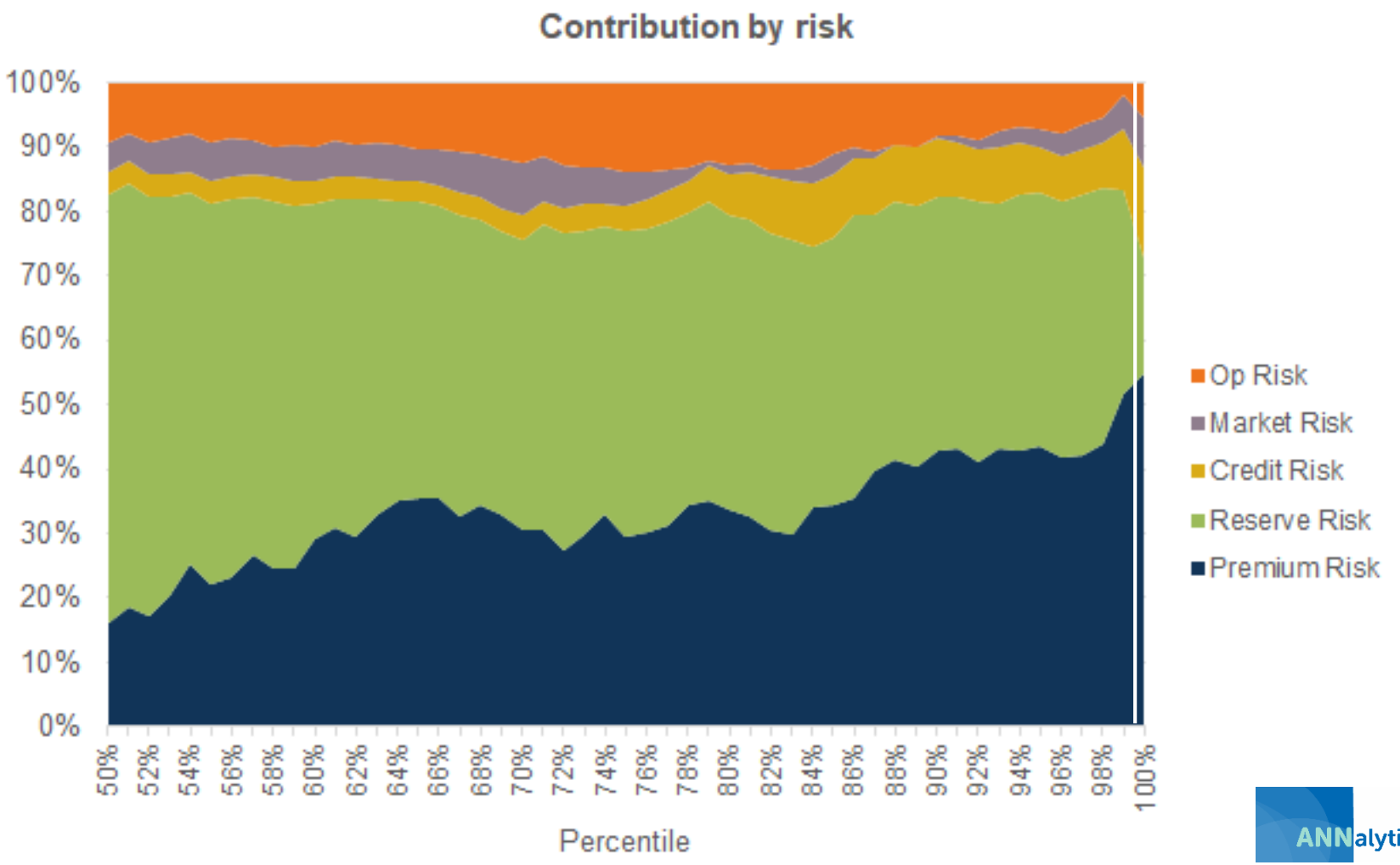
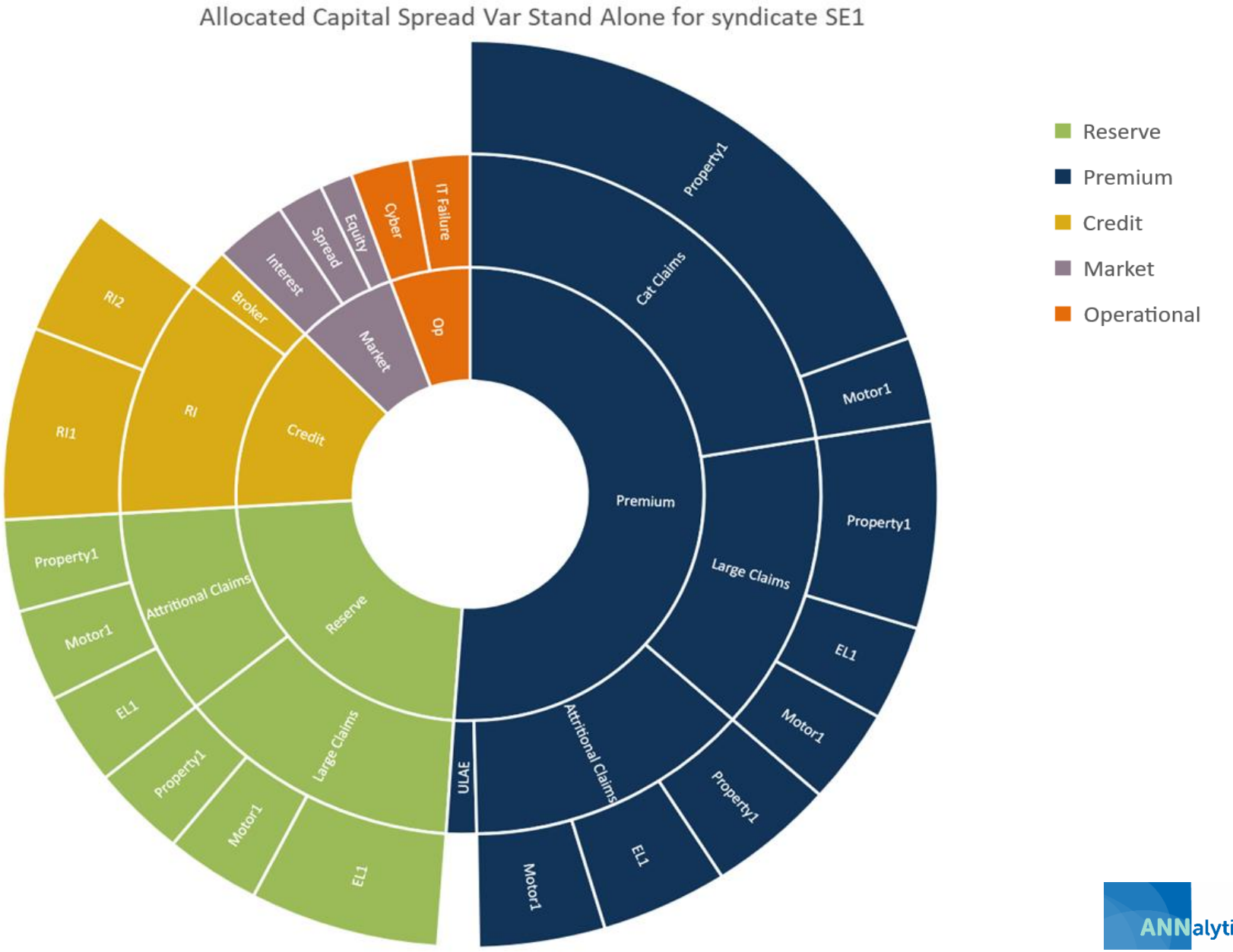


Risk ranking

Contribution to capital



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- Change analysis
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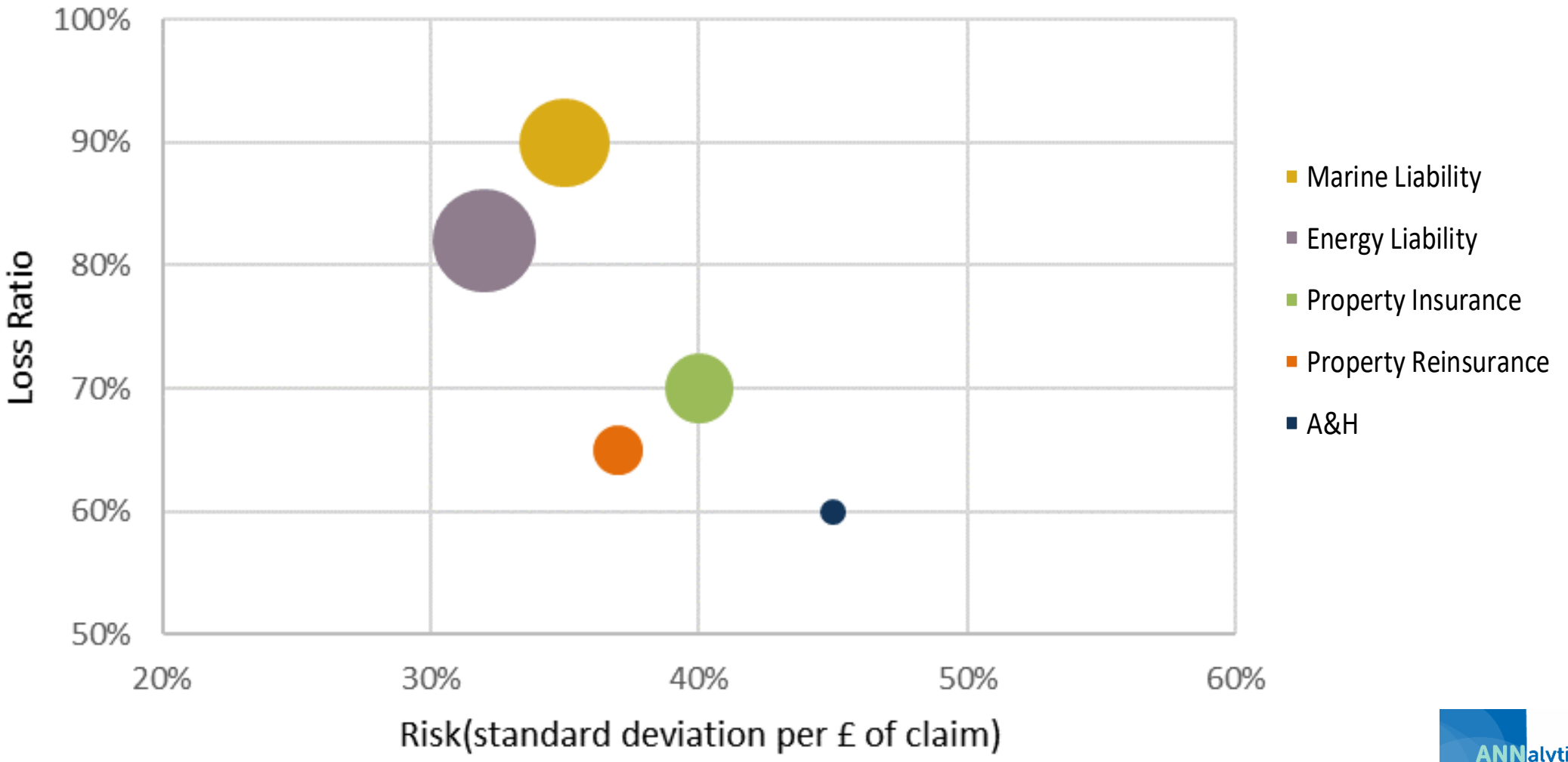
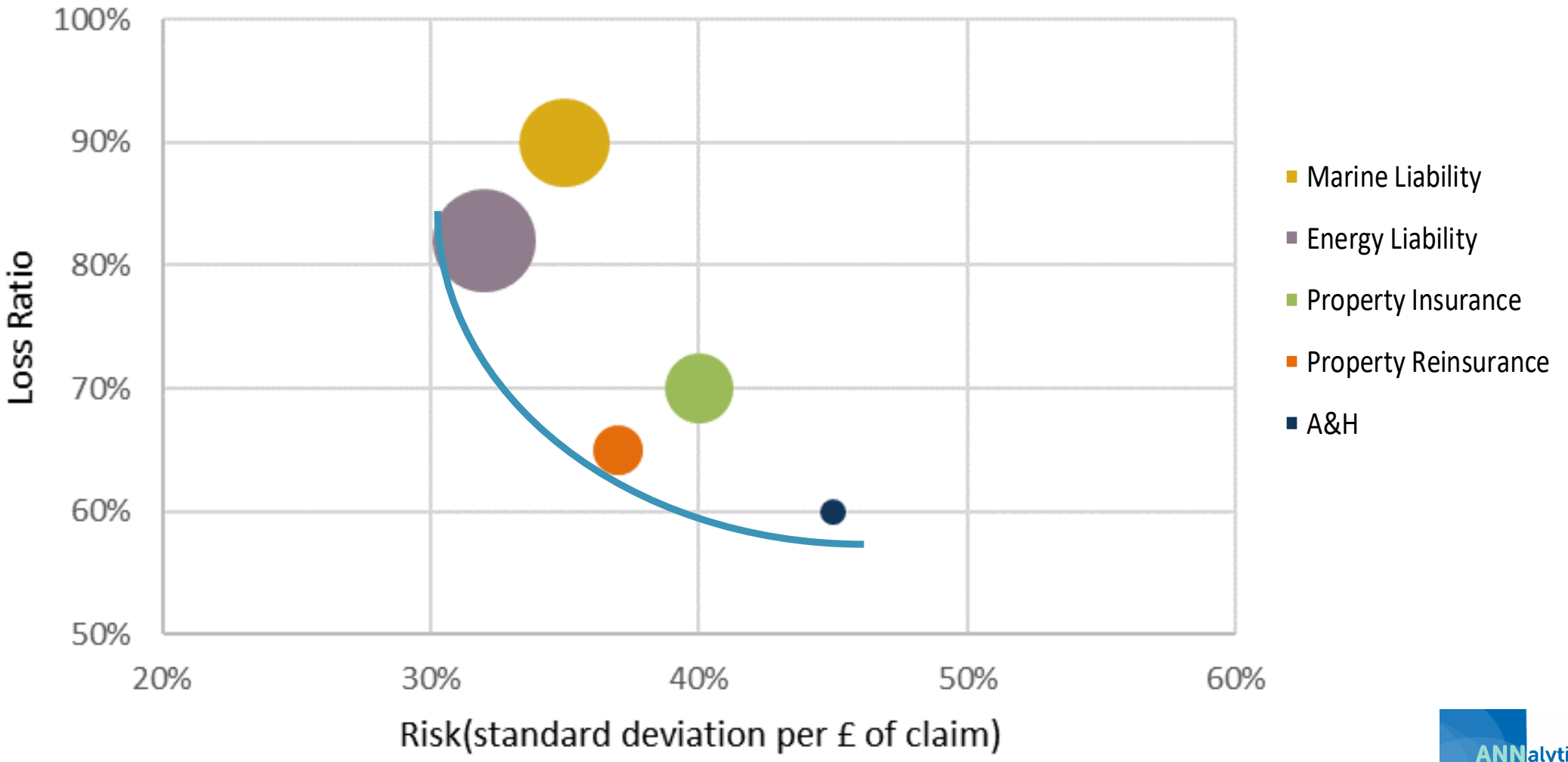
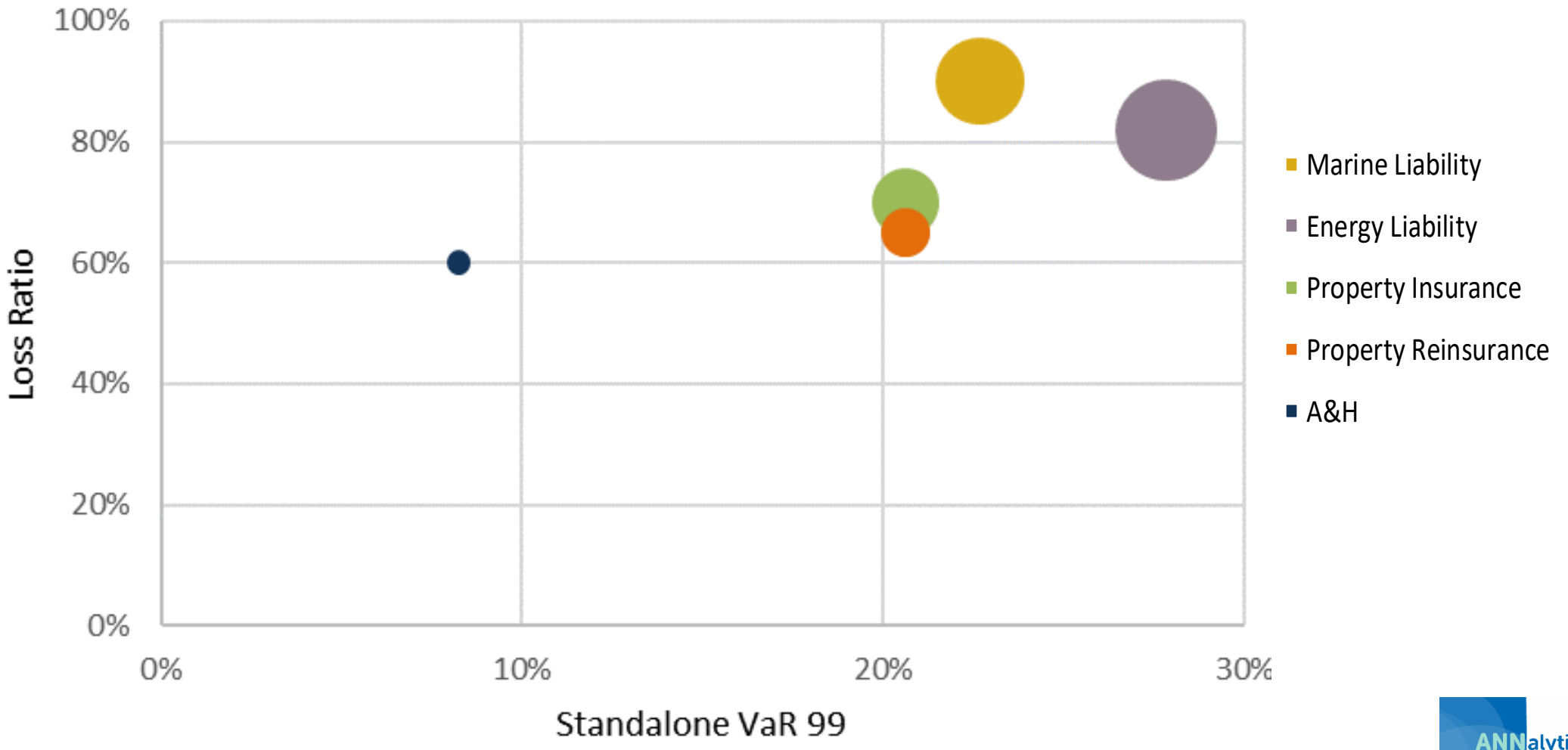
Risk and reward



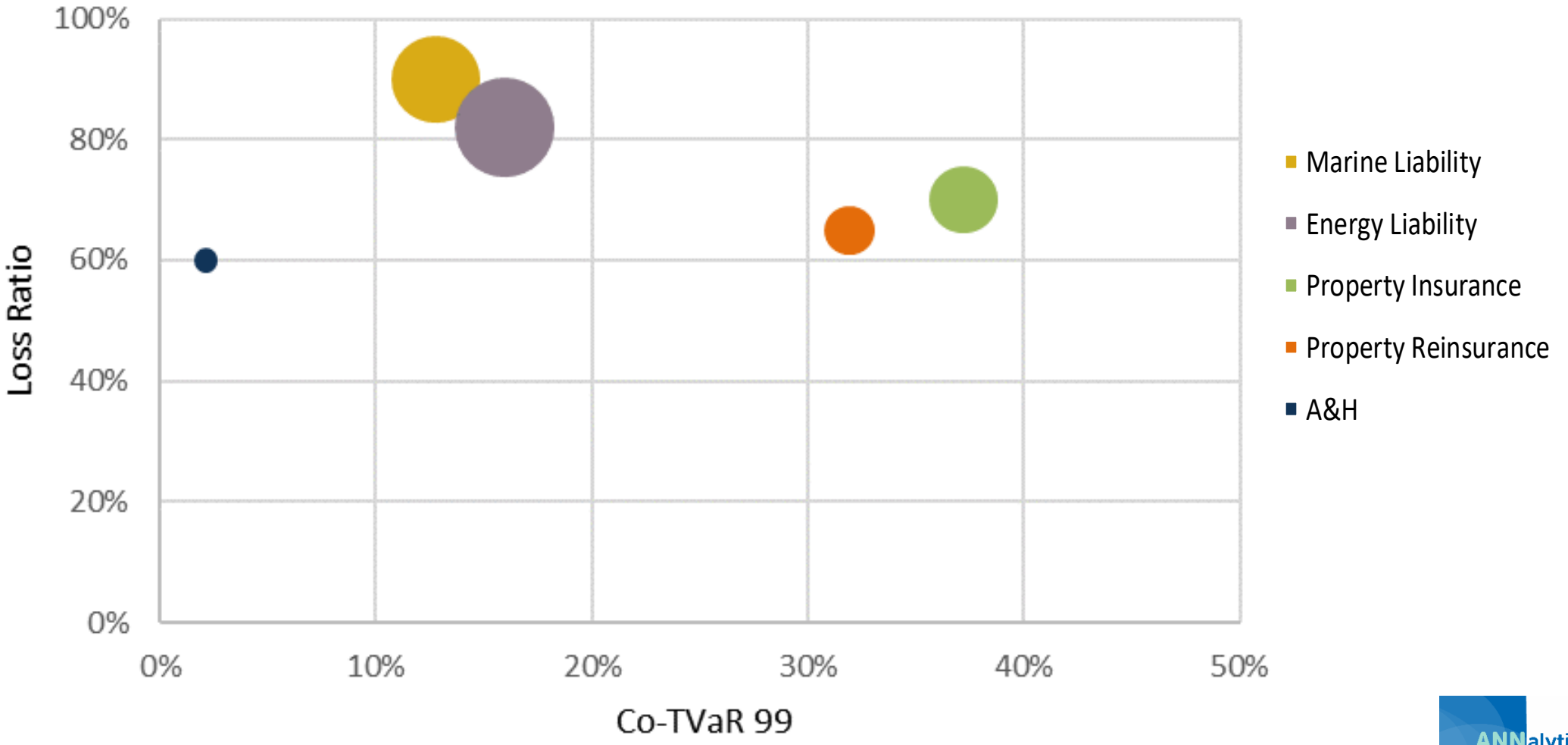
Risk and reward



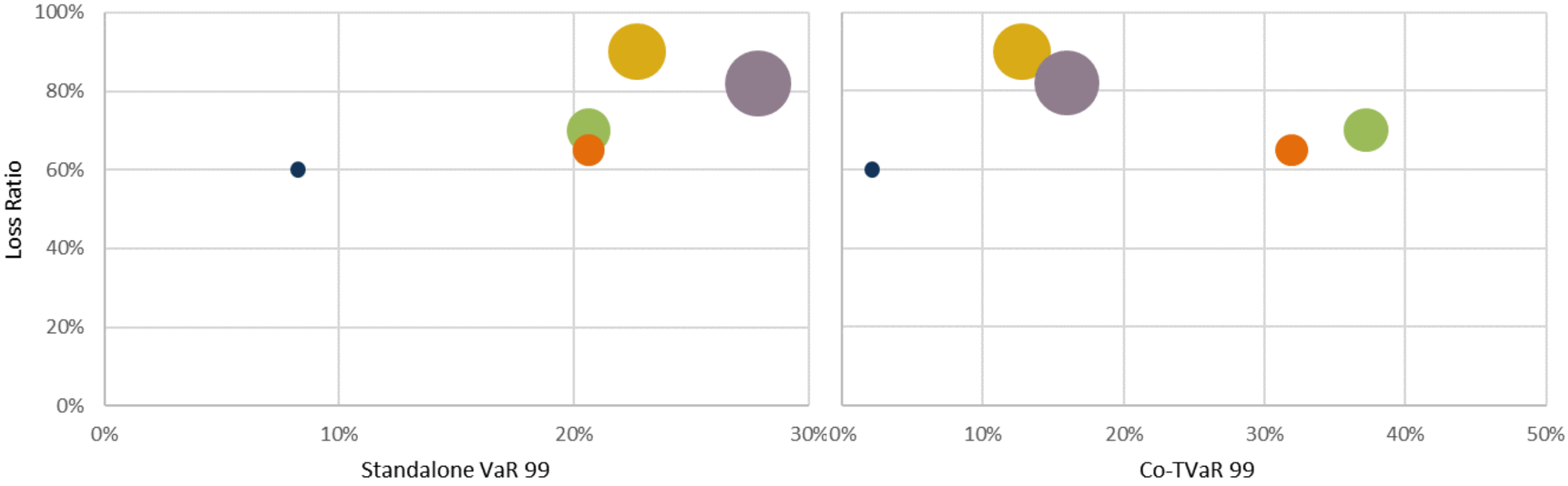
Risk and reward



Risk and reward



Risk and reward



Use in capital modelling?

- Risk ranking
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- **Correlations**
- Model fitting and back-testing
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- …
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Correlations

1	2	3	4	5	6	7	8	9	10
2	100%								
3	66%	100%							
4	11%	95%	100%						
5	75%	50%	35%	100%					
6	84%	90%	46%	29%	100%				
7	35%	11%	97%	49%	30%	100%			
8	16%	63%	62%	46%	90%	16%	100%		
9	86%	58%	4%	33%	86%	91%	67%	100%	
10	53%	59%	83%	67%	50%	52%	9%	46%	100%

		Equity	Credit spread	Interest rate	FX	Property	Bond default	Reinsurer default	Motor	Home	Legal	Liability	Current expenses	Expense inflation	People	Processes	System	External
Market	Equity	100%	0%	10%	5%	10%	25%	75%	80%	50%	10%	10%	75%	75%	75%	0%	10%	-15%
	Credit spread	0%	100%	80%	80%	-15%	-10%	25%	-10%	25%	-15%	5%	80%	25%	50%	5%	50%	-15%
	Interest rate	10%	80%	100%	10%	-10%	75%	50%	5%	-5%	0%	5%	-5%	80%	-10%	50%	75%	5%
	FX	5%	80%	10%	100%	25%	10%	50%	50%	80%	80%	0%	5%	-15%	50%	5%	75%	-15%
	Property	10%	-15%	-10%	25%	100%	80%	75%	75%	50%	5%	5%	75%	-15%	80%	-10%	0%	80%
Credit	Bond default	25%	-10%	75%	10%	80%	100%	75%	25%	-5%	5%	25%	-15%	-15%	5%	80%	75%	25%
	Reinsurer default	75%	25%	50%	50%	75%	75%	100%	-5%	50%	5%	80%	10%	75%	25%	-10%	0%	80%
Non-life	Motor	80%	-10%	5%	50%	75%	25%	-5%	100%	0%	10%	-5%	25%	-10%	50%	10%	25%	25%
	Home	50%	25%	-5%	80%	50%	-5%	50%	0%	100%	80%	25%	-15%	75%	10%	5%	75%	50%
	Legal	10%	-15%	0%	80%	5%	5%	5%	10%	80%	100%	-10%	5%	-10%	-10%	5%	25%	75%
	Liability	10%	5%	5%	0%	5%	25%	80%	-5%	25%	-10%	100%	80%	75%	25%	10%	-5%	0%
Expense	Current expenses	75%	80%	-5%	5%	75%	-15%	10%	25%	-15%	5%	80%	100%	-15%	10%	10%	5%	25%
	Expense inflation	75%	25%	80%	-15%	-15%	-15%	75%	-10%	75%	-10%	75%	-15%	100%	-15%	5%	-10%	50%
Operational	People	75%	50%	-10%	50%	80%	5%	25%	50%	10%	-10%	25%	10%	-15%	100%	-15%	10%	80%
	Processes	0%	5%	50%	5%	-10%	80%	-10%	10%	5%	5%	10%	10%	5%	-15%	100%	50%	75%
	System	10%	50%	75%	75%	0%	75%	0%	25%	75%	25%	-5%	5%	-10%	10%	50%	100%	-15%
	External	-15%	-15%	5%	-15%	80%	25%	80%	25%	50%	75%	0%	25%	50%	80%	75%	-15%	100%

Vs

		Equity	Credit spread	Interest rate	FX	Property	Bond default	Reinsurer default	Motor	Home	Legal	Liability	Current expenses	Expense inflation	People	Processes	System
Market	Equity																
	Credit spread	□															
	Interest rate	▲	▲														
	FX	▲	▲	▲													
	Property	▲	▼	▼	▲												
Credit	Bond default	▲	▼	▲	▲	▲											
	Reinsurer default	▲	▲	▲	▲	▲	▲										
Non-life	Motor	▲	▼	▲	▲	▲	▲	▼									
	Home	▲	▲	▼	▲	▲	▼	▲	□								
	Legal	▲	▼	□	▲	▲	▲	▲	▲	▲							
	Liability	▲	▲	▲	□	▲	▲	▲	▼	▲	▼						
Expense	Current expenses	▲	▲	▼	▲	▲	▼	▲	▲	▼	▲	▲					
	Expense inflation	▲	▲	▲	▼	▼	▼	▲	▼	▲	▼	▲	▼				
Operational	People	▲	▲	▼	▲	▲	▲	▲	▲	▲	▼	▲	▲	▼			
	Processes	□	▲	▲	▲	▼	▲	▼	▲	▲	▲	▲	▲	▲	▼		
	System	▲	▲	▲	▲	□	▲	□	▲	▲	▲	▼	▲	▼	▲	▲	
	External	▼	▼	▲	▼	▲	▲	▲	▲	▲	▲	□	▲	▲	▲	▲	▼

▼ <-10%
▼ -10% to -5%
▼ -5% to -0.1%
□ 0%
▲ 0.01% to 25%
▲ 25% to 50%
▲ >50%

Correlations

- What about input calibrations?
- You are asked to justify your input correlations:

		Accident & Health	Cargo & Specie	Energy Property	Marine & Energy Liability	Marine Hull	Professional Indemnity	Political Risk
1	Accident & Health							
5	Cargo & Specie	10%						
7	Energy Property	10%	29%					
11	Marine & Energy Liability	10%	11%	1%				
12	Marine Hull	5%	22%	22%	14%			
17	Professional Indemnity	11%	8%	8%	8%	20%		
18	Political Risk	25%	9%	9%	9%	9%	30%	

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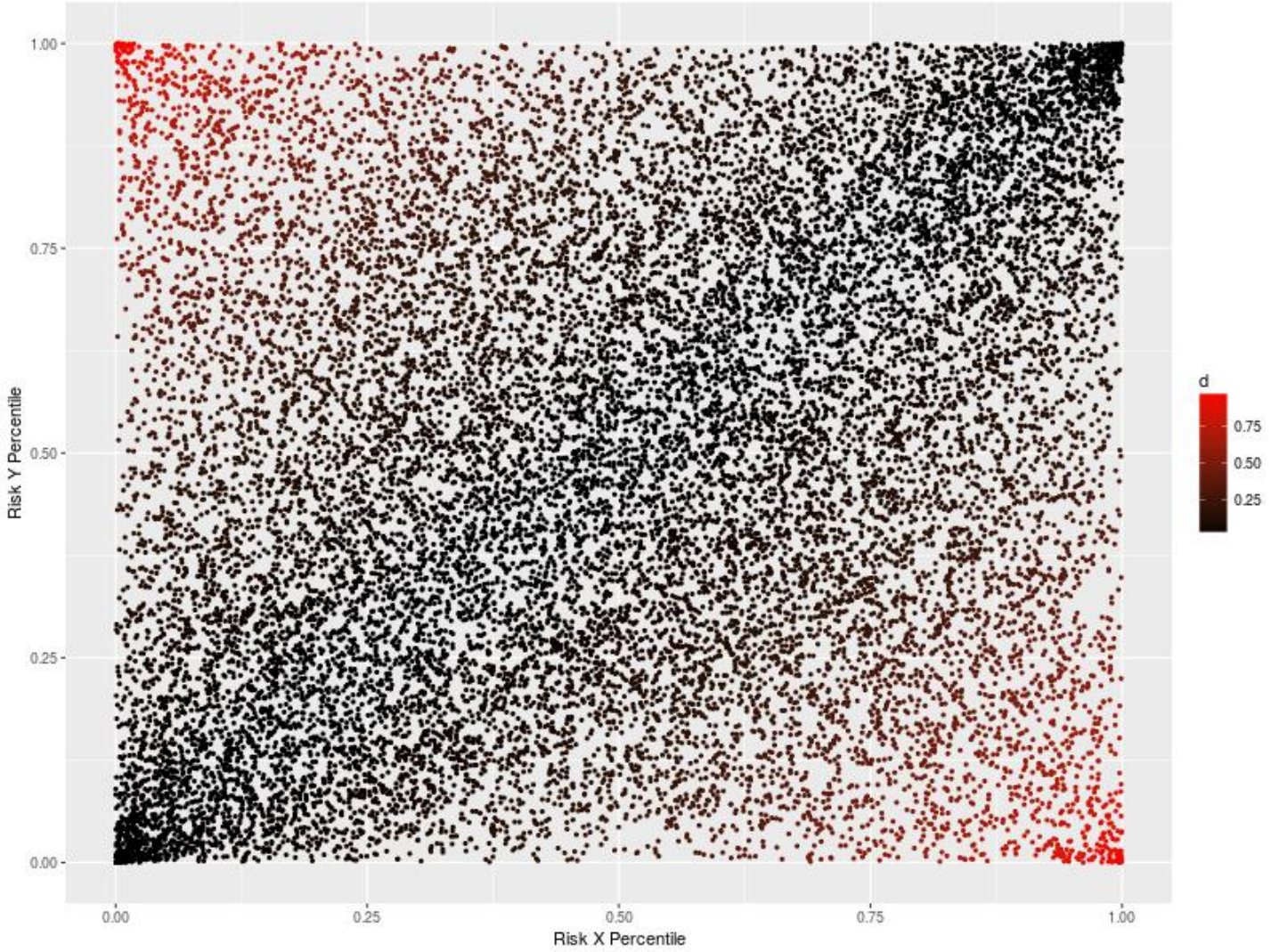
Correlations



Red shows ‘anti-correlated’ simulations

Correlations

Premium Risk vs Reserve Risk

		CEP				Ratio vs Independence	
Percentile	Return period	Independence	Achieved	What if I used Gumbel?	Dependence	Achieved	What if I used Gumbel?
90.0%	1 in 10	10.0%	54.2%	70.1%	100%	5.42	7.01
95.0%	1 in 20	5.0%	52.8%	69.1%	100%	10.56	13.81
97.5%	1 in 40	2.5%	45.2%	68.5%	100%	18.08	27.41
99.0%	1 in 100	1.0%	35.0%	68.2%	100%	35.00	68.19
99.5%	1 in 200	0.5%	24.0%	68.1%	100%	48.00	136.18

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Correlations

Premium Risk vs Reserve Risk

		CEP				Ratio vs Independence	
Percentile	Return period	Independence	Achieved	What if I used Gumbel?	Dependence	Achieved	What if I used Gumbel?
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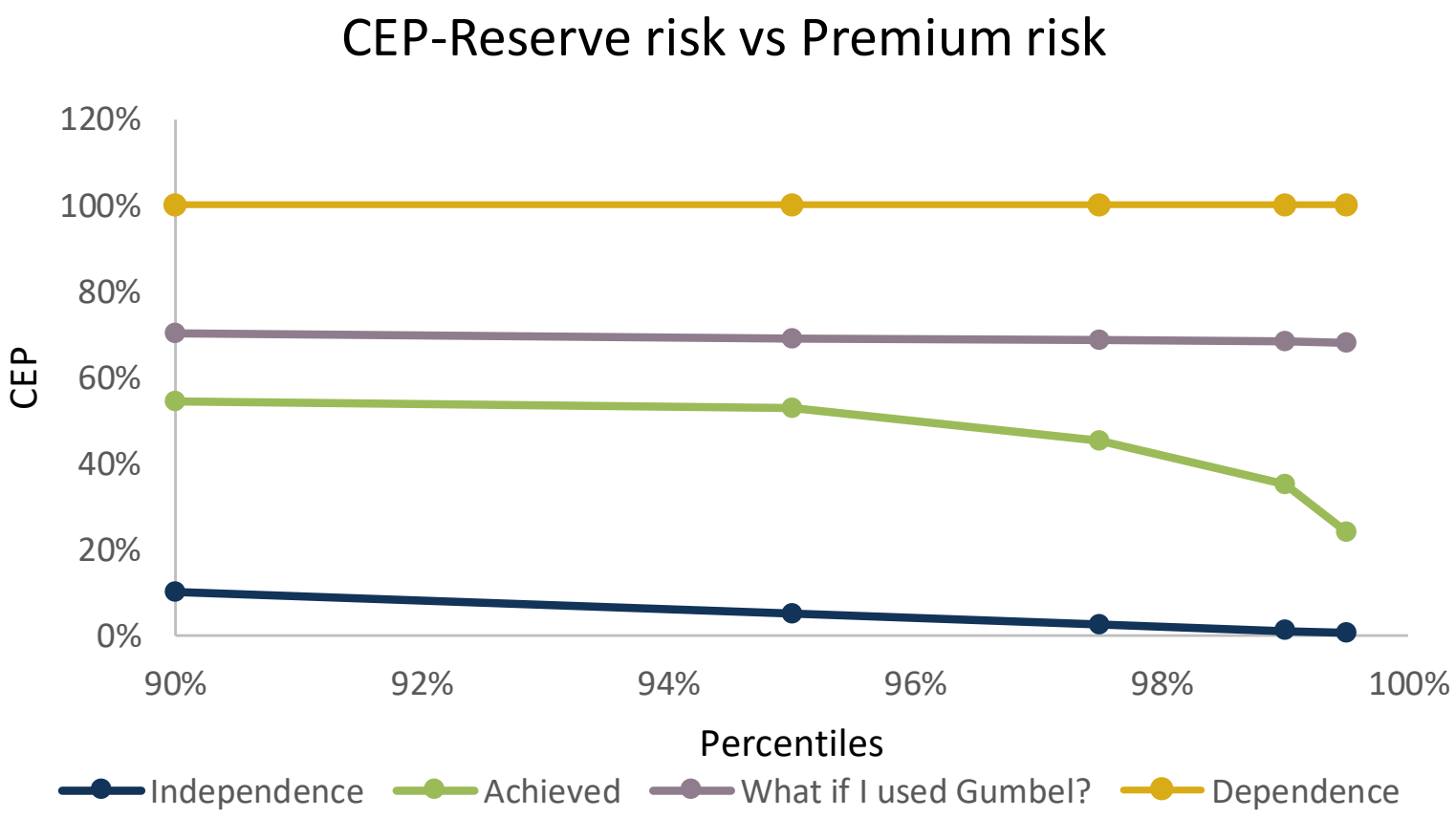
97.5%	1 in 40	2.5%	45.2%	68.5%	100%	18.08	27.41
99.0%	1 in 100	1.0%	35.0%	68.2%	100%	35.00	68.19
99.5%	1 in 200	0.5%	24.0%	68.1%	100%	48.00	136.18



Use in capital modelling?

- Risk ranking
- Risk and reward
- Correlations
- **Model fitting and back-testing**
- Model stability
- …
- Change analysis
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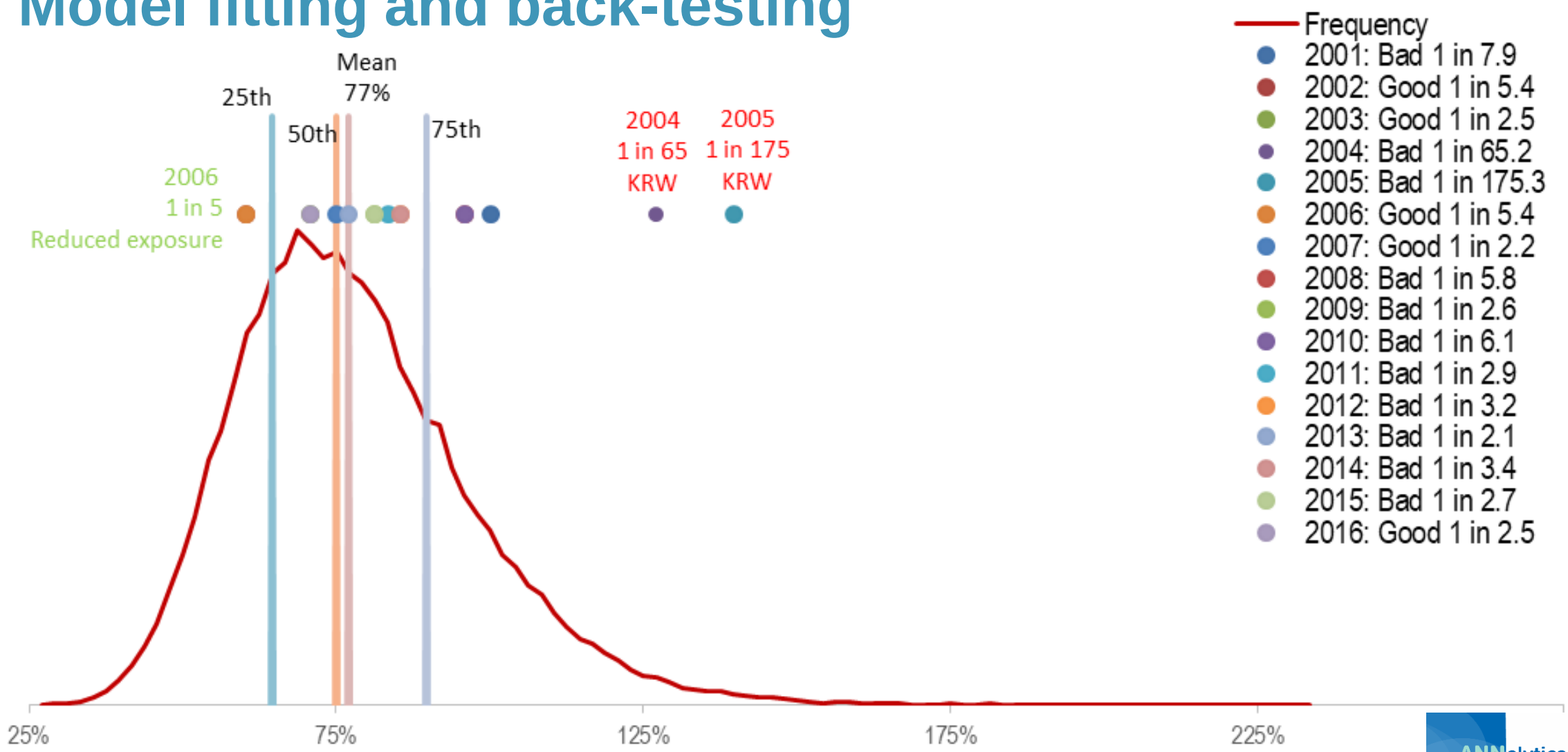
- Profit and loss attribution
- …

Model fitting and back-testing

UWY	GNLR	Percentile	Return Period
2001	99%	87.4%	1 in 7.9
2002	60%	18.5%	1 in 5.4
2003	70%	39.7%	1 in 2.5
2004	127%	98.5%	1 in 65.2
2005	140%	99.4%	1 in 175.3
2006	60%	18.5%	1 in 5.4
2007	73%	46.3%	1 in 2.2
2008	94%	82.6%	1 in 5.8
2009	80%	61.1%	1 in 2.6
2010	95%	83.7%	1 in 6.1
2011	82%	65.1%	1 in 2.9
2012	84%	68.7%	1 in 3.2
2013	76%	53.0%	1 in 2.1
2014	85%	70.4%	1 in 3.4
2015	81%	63.1%	1 in 2.7
2016	70%	39.7%	1 in 2.5

Model fitting and back-testing



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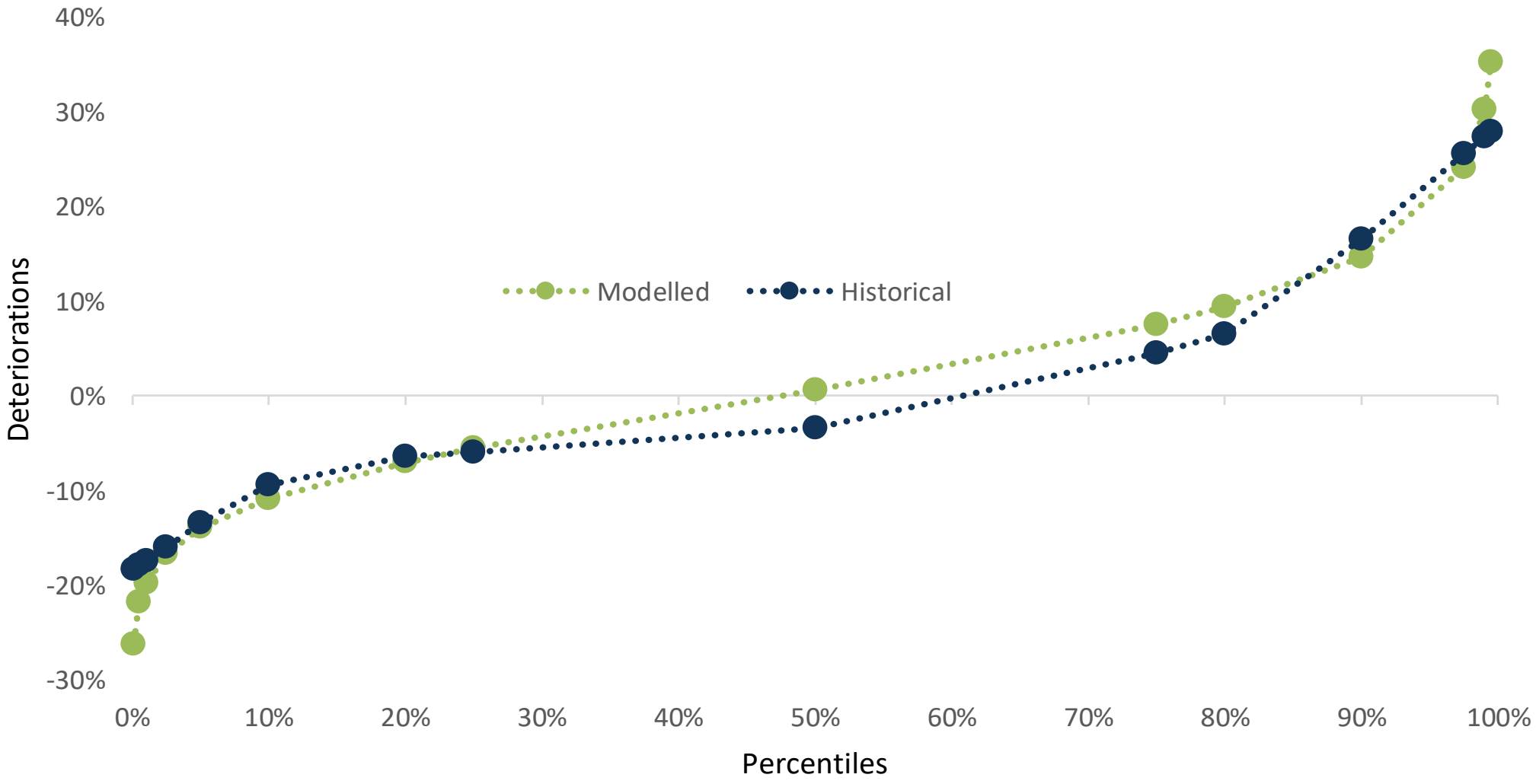
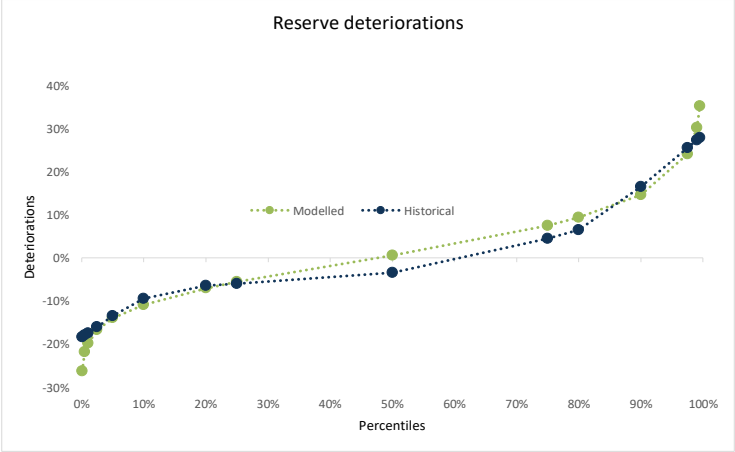
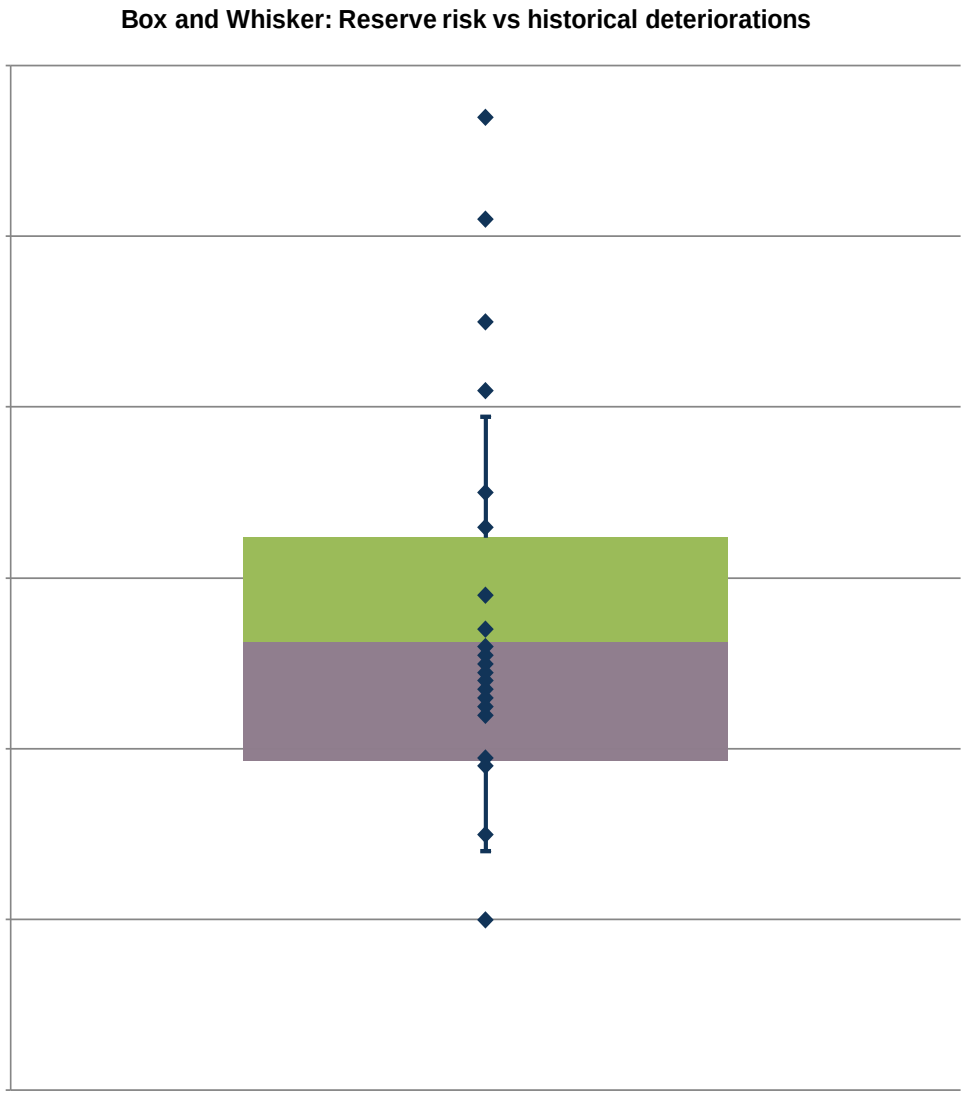
Model fitting and back-testing



Model fitting and back-testing

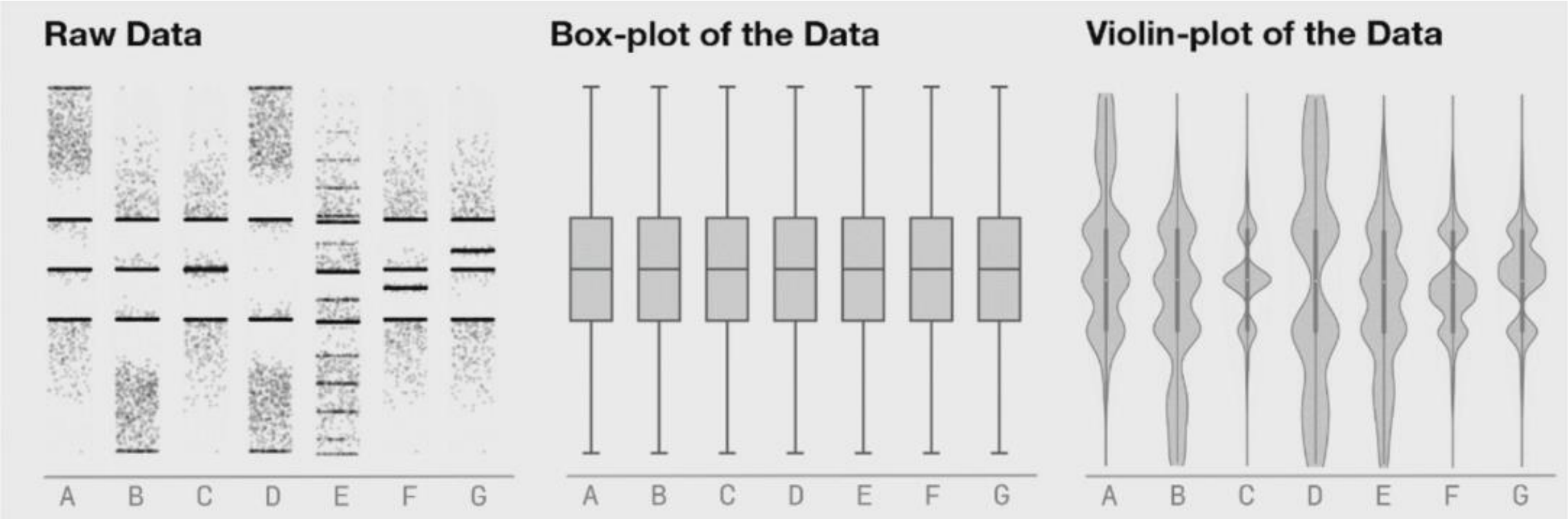


Vs



Model fitting and back-testing

This slide is a moving gif that shows the raw data changing and impacting the Violin-plots but not the Box-plots



https://blog.bioturing.com/2018/05/16/5-reasons-you-should-use-a-violin-graph/

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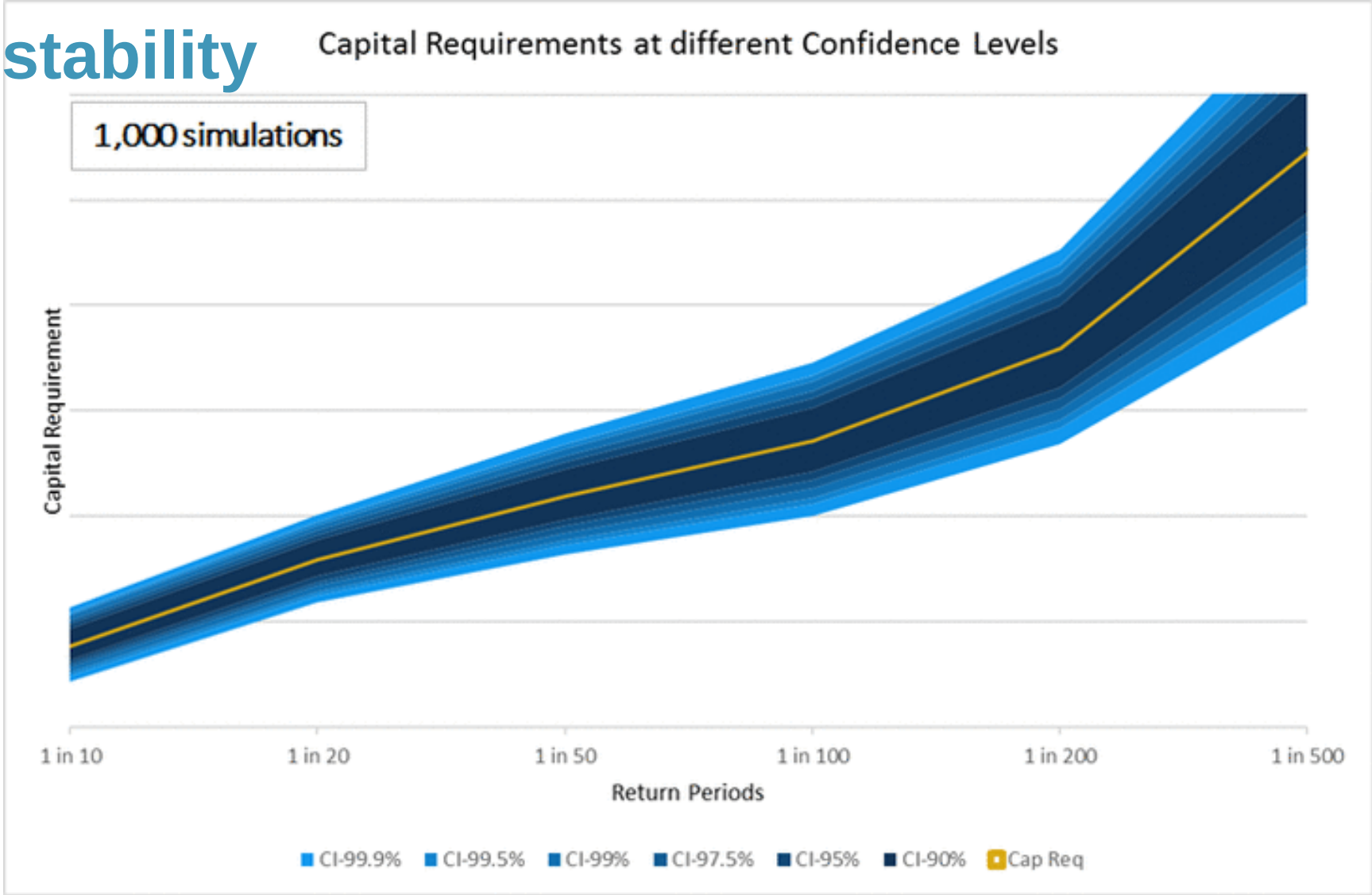
Model stability



This slide was a moving gif showing the capital at 1,000; 10,000 and 50,000 sims. The three charts are now shown on separate slides

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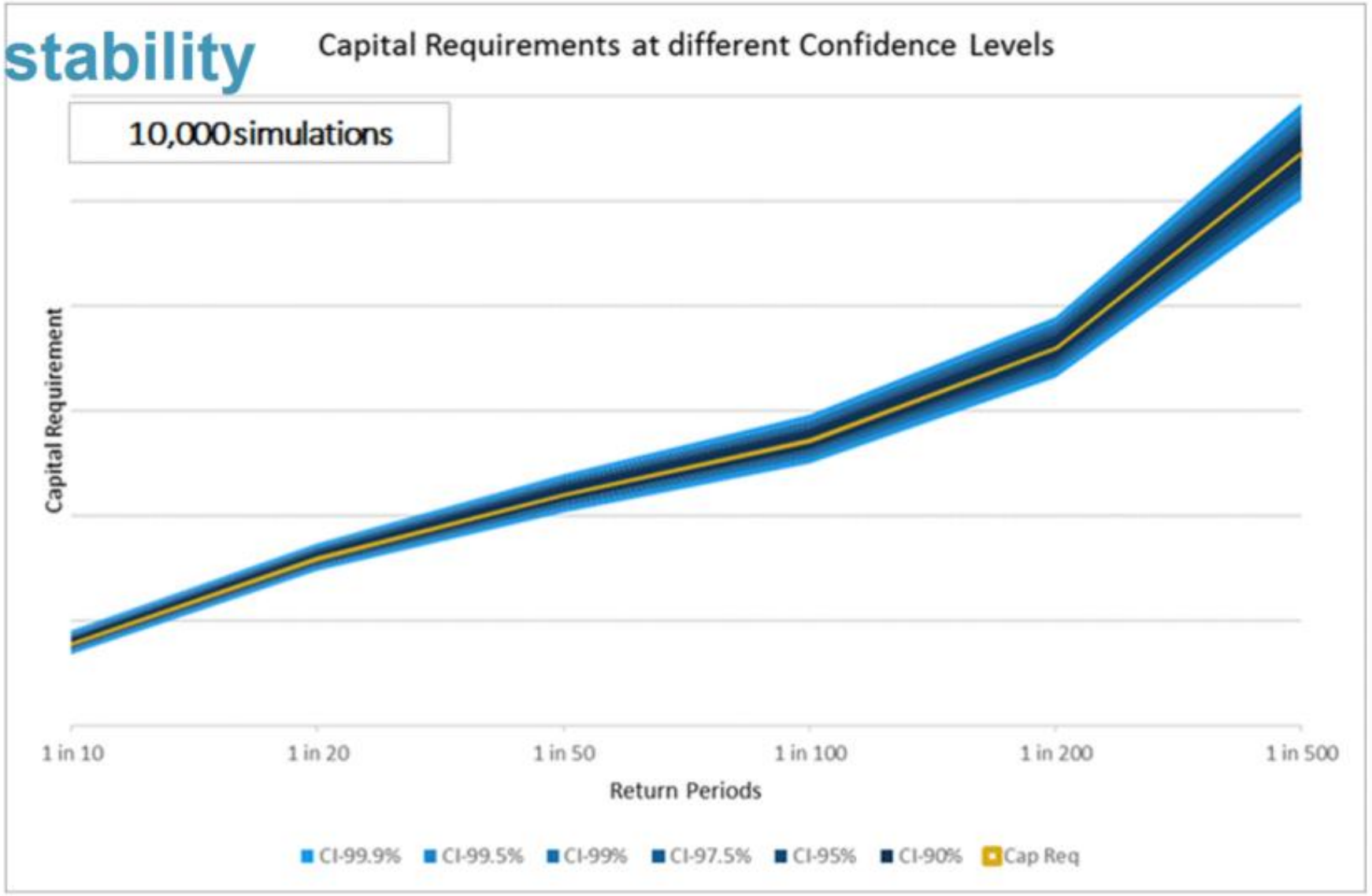
Model stability



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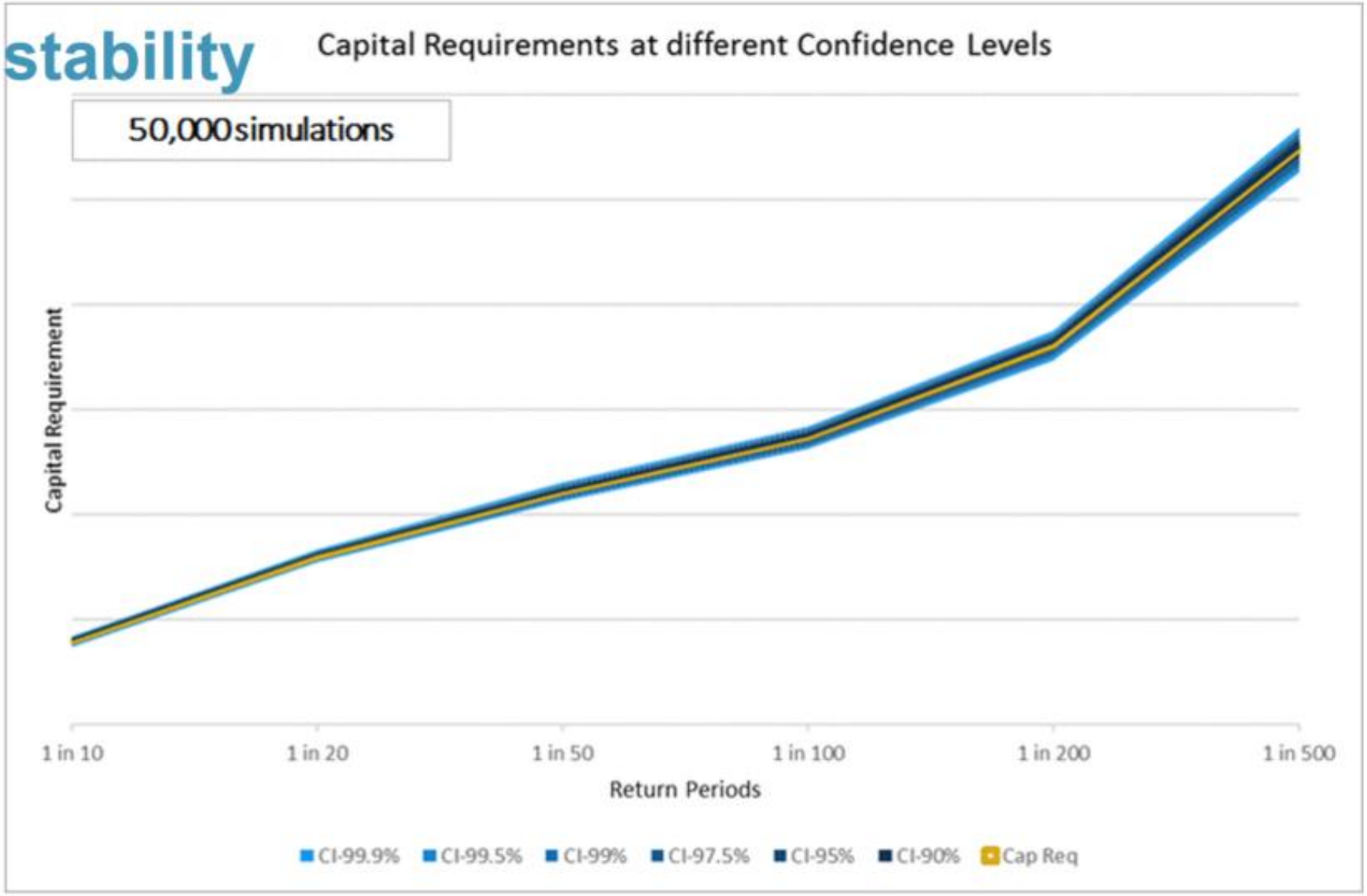
ANNalytica

Model stability



This slide was a moving gif showing the capital at 1,000; 10,000 and 50,000 sims. The three charts are now shown on separate slides

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Use in capital modelling?

- Risk ranking
- Risk and reward
- Correlations
- Model fitting and back-testing
- Model stability
- …
- Change analysis
- Granular risk ranking
- Profit and loss attribution
- …

Visualisation challenges to overcome

Company specific visuals adopted

Refinements made each year

New graphics designed due to ad-hoc nature

Some visuals very **effective**, others **less so**

Significant amount of **processing** time

Processes and software solutions must **facilitate**

Enables more time **thinking about the "why?"**

Image source: https://www.pexels.com/

Visualisation challenges to overcome

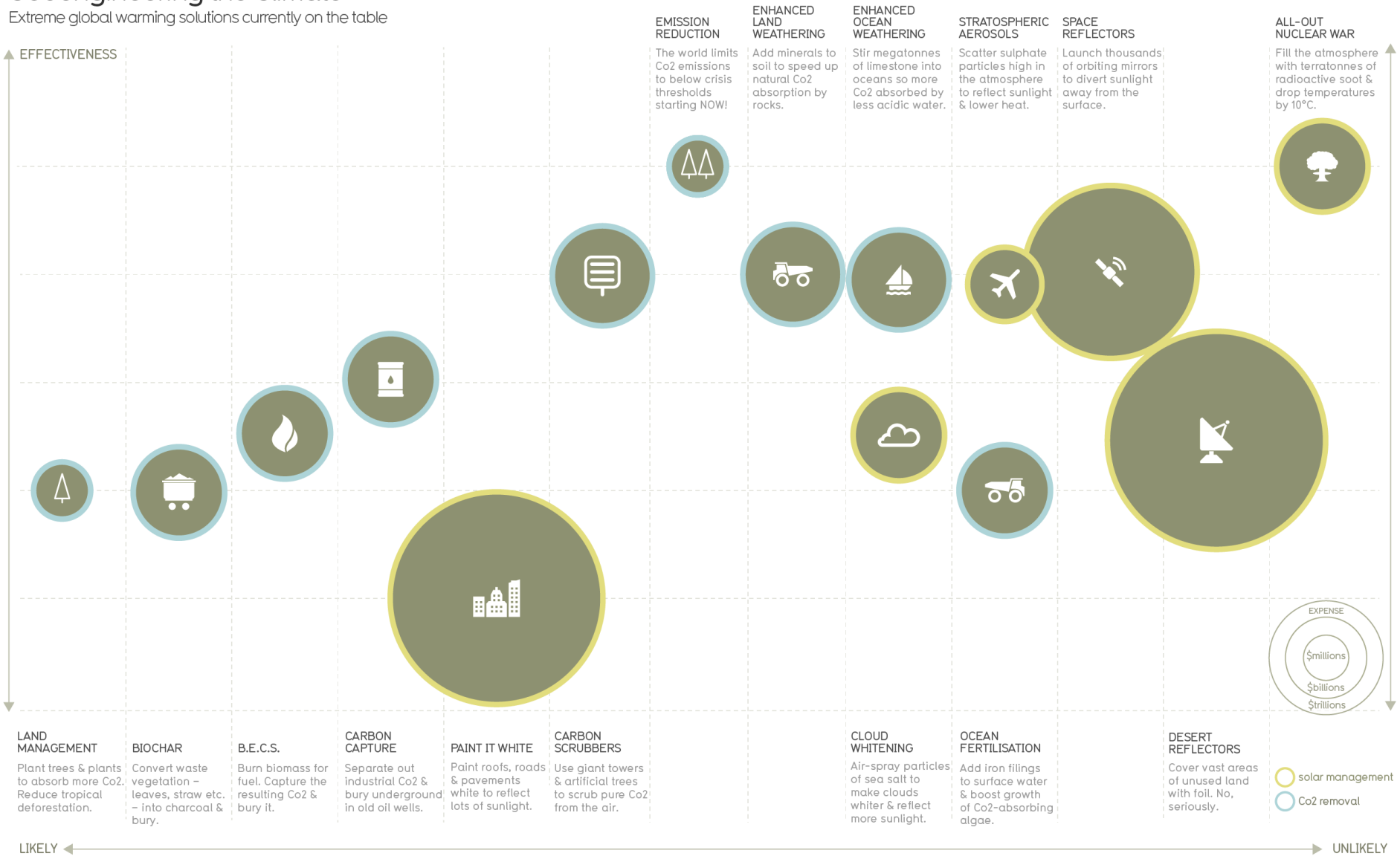
How to combine visualisation with other medium?

Documentation in video format?

Image source: https://www.pexels.com/

Geoengineering the Climate

Extreme global warming solutions currently on the table



design & concept: David McCandless
research: Miriam Quick
version: 1.5 - Feb 2015

InformationisBeautiful.net
from the new book Knowledge is Beautiful bit.ly/KIB_books

source: Carbon Tracker, Royal Society: "Geoengineering the Climate" (2009)
data: bit.ly/KIB_ClimateFixes

Capital Estimation Methods

Methods Insurers could use to estimate their required capital

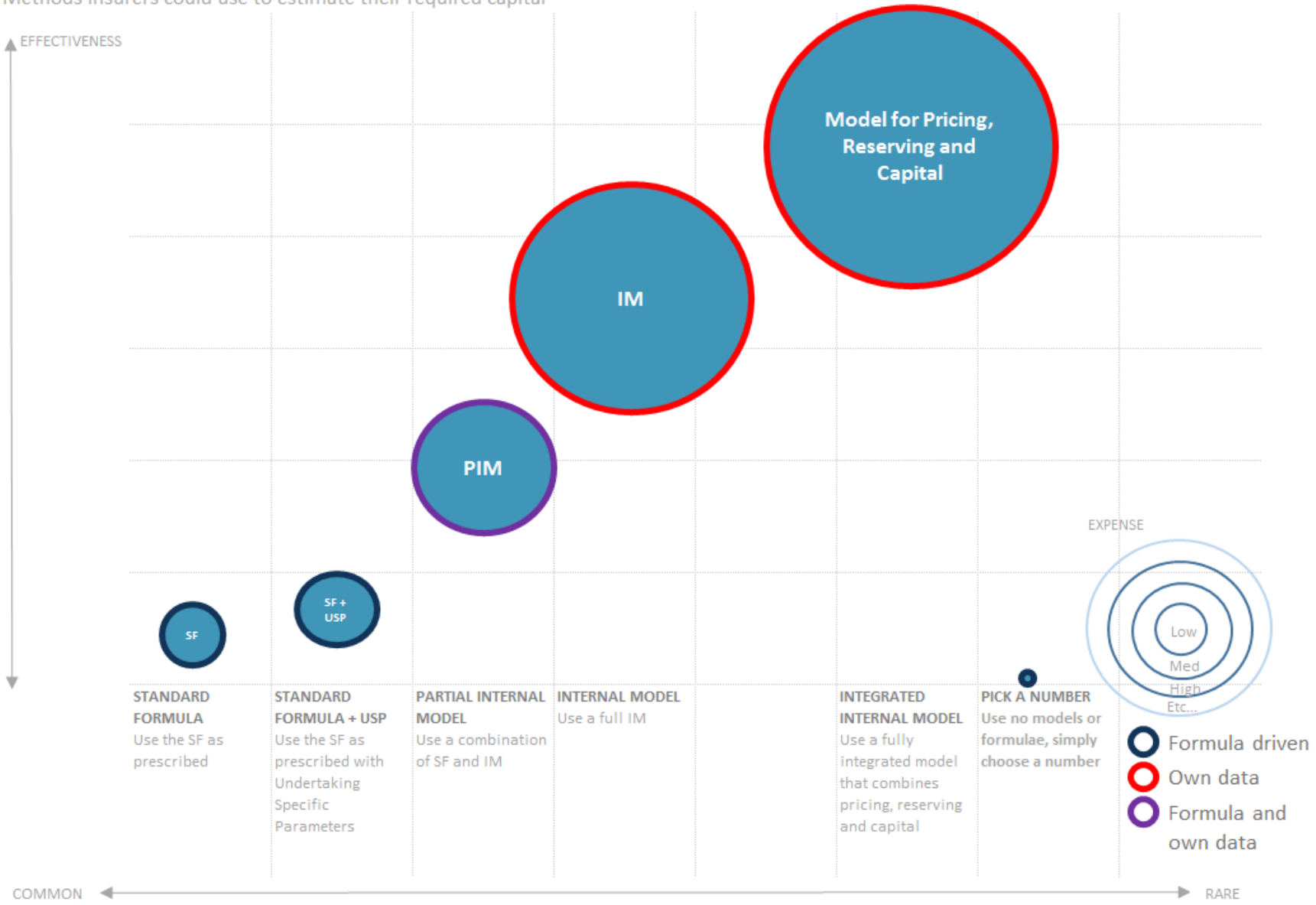
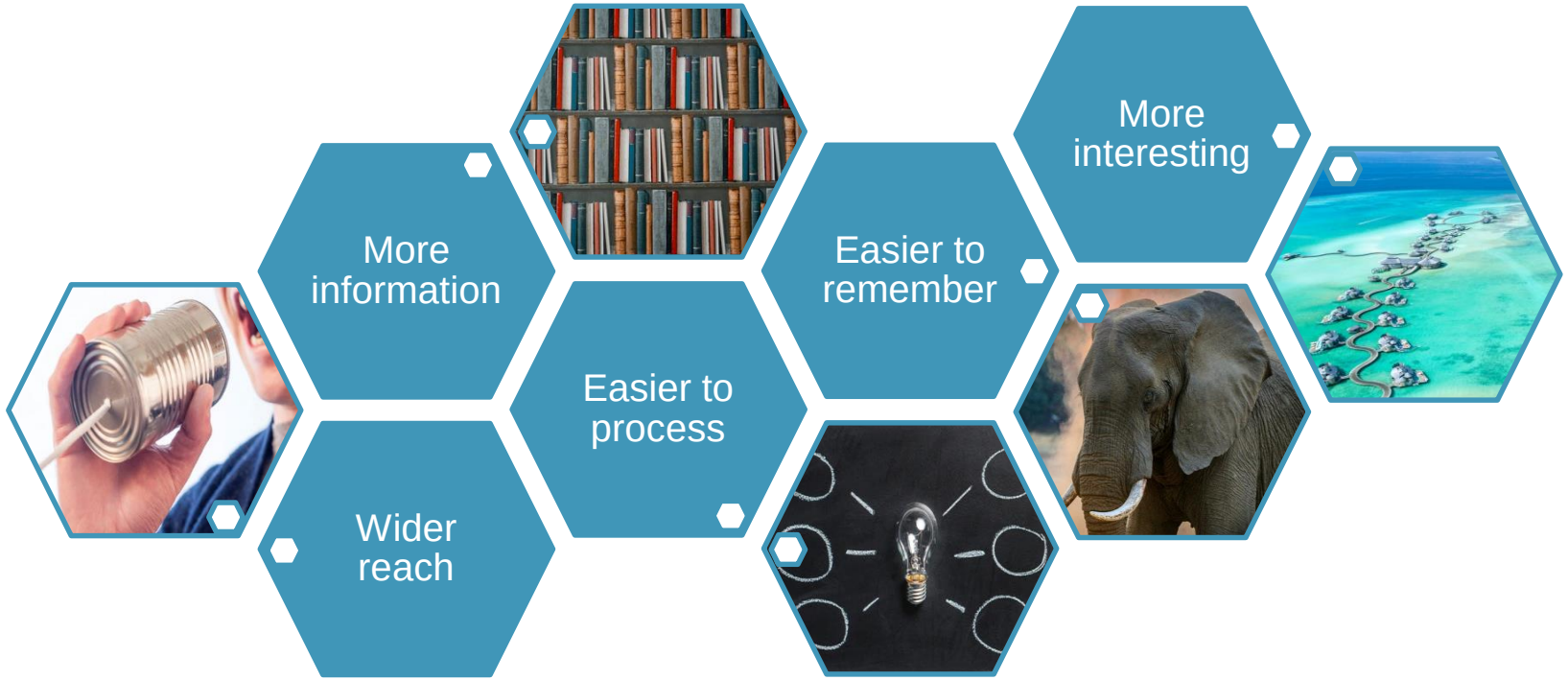


Chart idea: https://www.informationisbeautiful.net

Communicating Models Effectively Summary



Better understanding of modelling and calibrations

Capital Modelling

More time thinking about the "why?"

Must be **fit for purpose**

Image source: https://www.pexels.com/

Questions

Comments

Thank you

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