LLOYD'S

The Evolution in Disaster Scenarios at Lloyd's

Dr Trevor Maynard

6 September 2017

LLOYD'S Short-Tail Accumulation Risk:
materiality ranking & methodologies

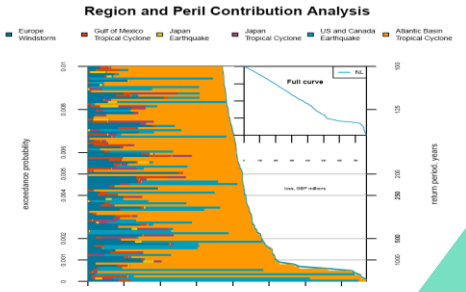
USWS
NA EQ
EURO WS
JP EQ
JP TY

UK Flood

Marine
Energy
Space etc

Australia
China etc

Puerto Rico



Top 5

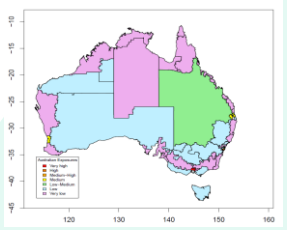
region/perils

probabilistic (LCM)

and deterministic (RDS)

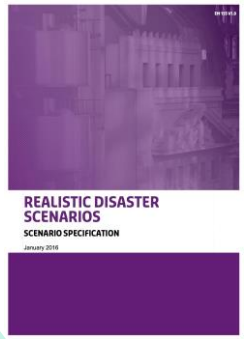
other region/perils
&
other accumulation risks

deterministic only (RDS)



potentially material region/perils
compulsory aggregate exposures

other region/perils
'next top 5' aggregate exposures



Materiality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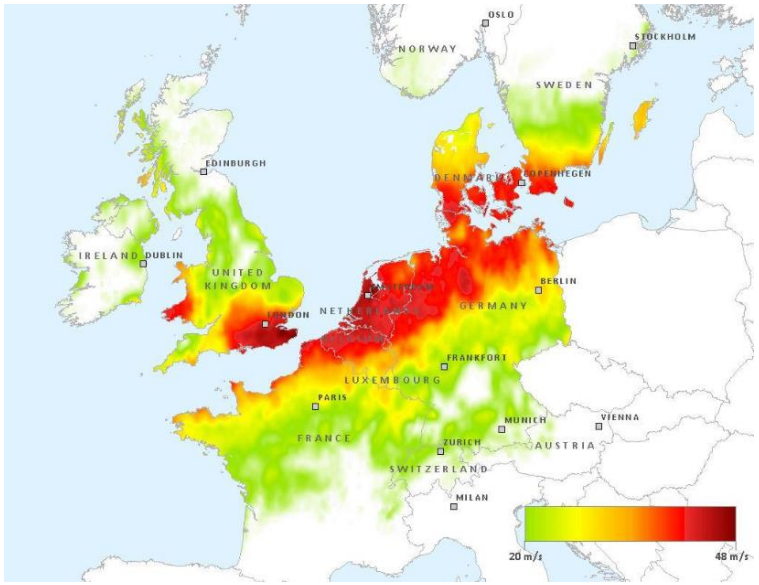
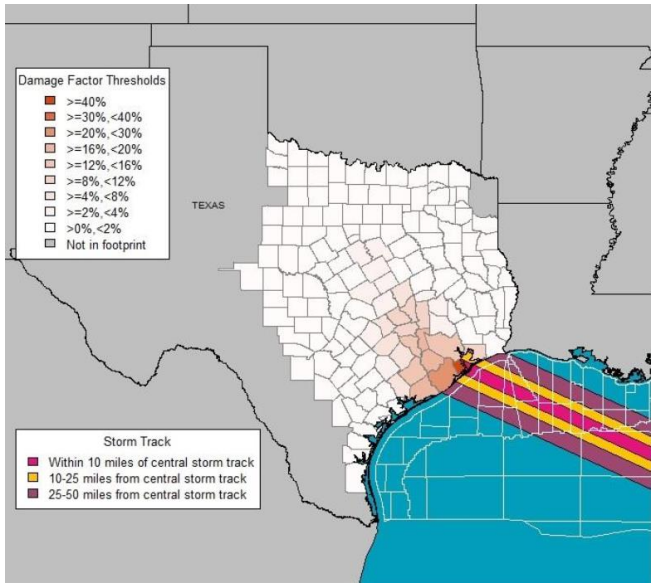
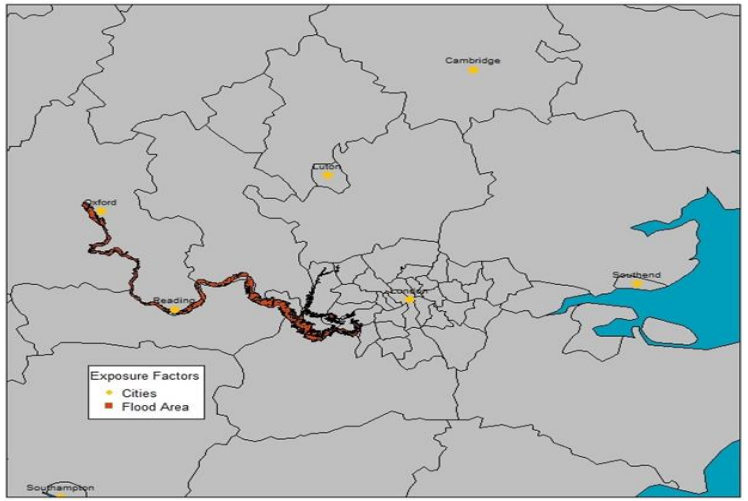
Hells Kitchen
New York
Manhattan
Murray Hill


OSLO
NORWAY
STOCKHOLM
SWEDEN
EDINBURGH
DENMARK
COPENHAGEN
IRELAND
DUBLIN
UNITED KINGDOM
BERLIN
GERMANY
LONDON
NETHERLANDS
FRANKFORT
LUXEMBOURG
PARIS
MUNICH
VIENNA
FRANCE
ZURICH
AUSTRIA
SWITZERLAND
MILAN
20 m/s
48 m/s

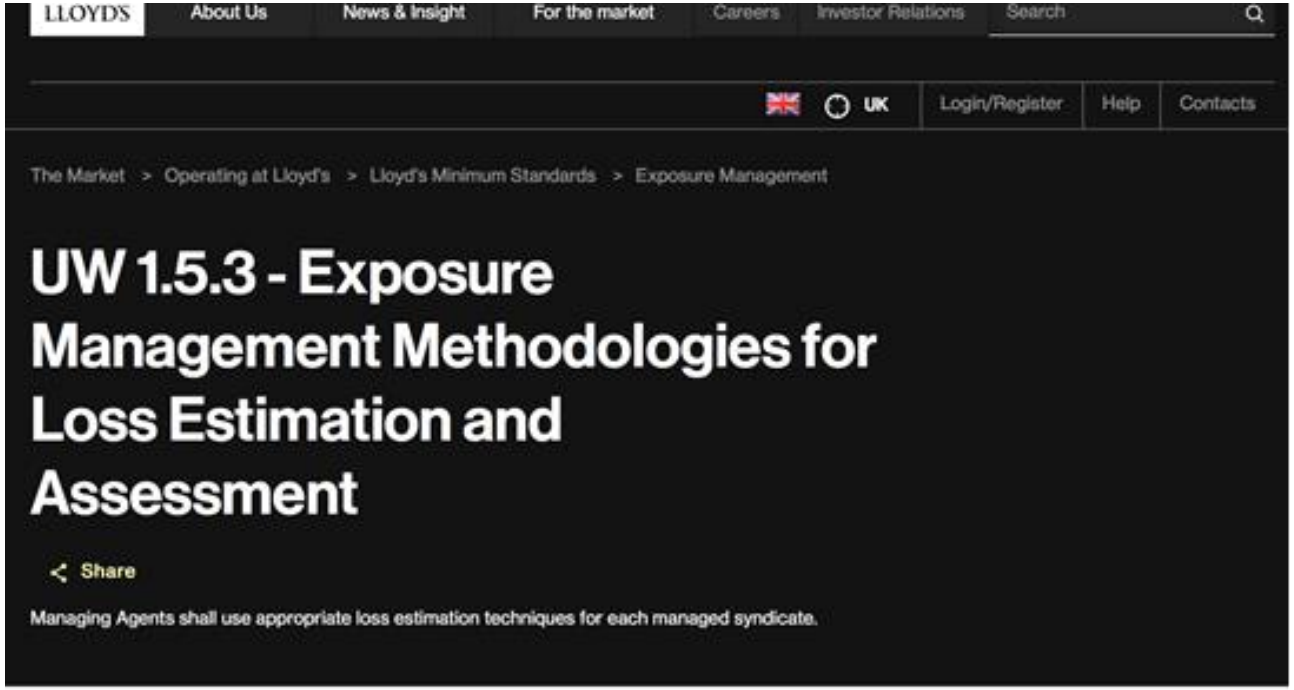

Damage Factor Thresholds
>=40%
>=30%,<40%
>=20%,<30%
>=16%,<20%
>=12%,<16%
>=8%,<12%
>=4%,<8%
>=2%,<4%
>0%,<2%
Not in footprint
TEXAS
Storm Track
Within 10 miles of central storm track
10-25 miles from central storm track
25-50 miles from central storm track

Uk flood

- Scenario based on heavy rainfall event moving west to east across south-east England
- GBP 6.2bn (USD 9.7bn) industry insured loss
- Flood extent covers 194km^2 with impact on Oxford, Reading, Slough, and Henley
- Event duration will not exceed 168 hours
- Consider:
  - Pollution (e.g. Carlisle 2005)
  - Road/Rail/Airport disruption
  - CBI – supplier extensions

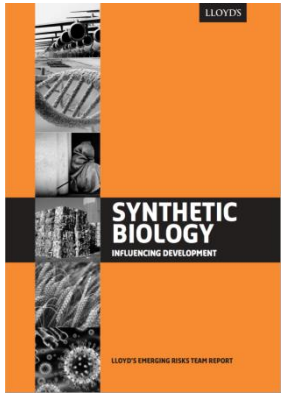


Residential	£4.50bn
Commercial/Industrial	£1.60bn
Agriculture	£0.05bn
Motor	£0.05bn



- there are formal processes to communicate material uncertainty to nominated committees and the board;

Emerging risks management



Identification

Horizon scanning

Evaluation

Judgment of significance

Awareness

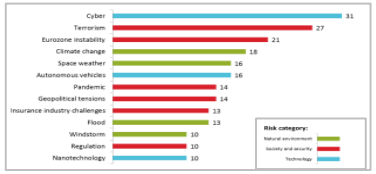
Thought leadership

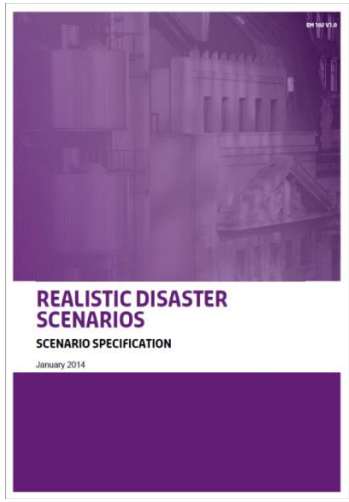
Assessment

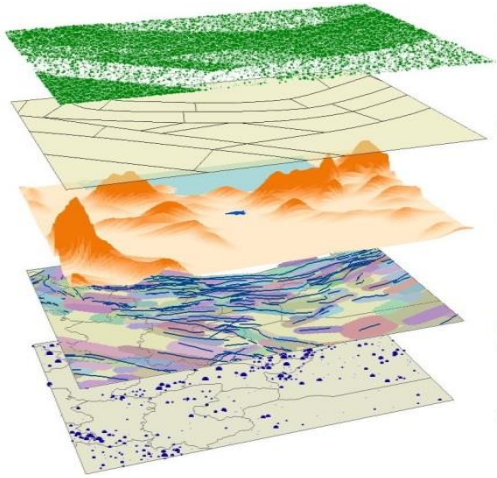
Decision-making resources (scenarios)

Quantification

For product innovation & exposure management







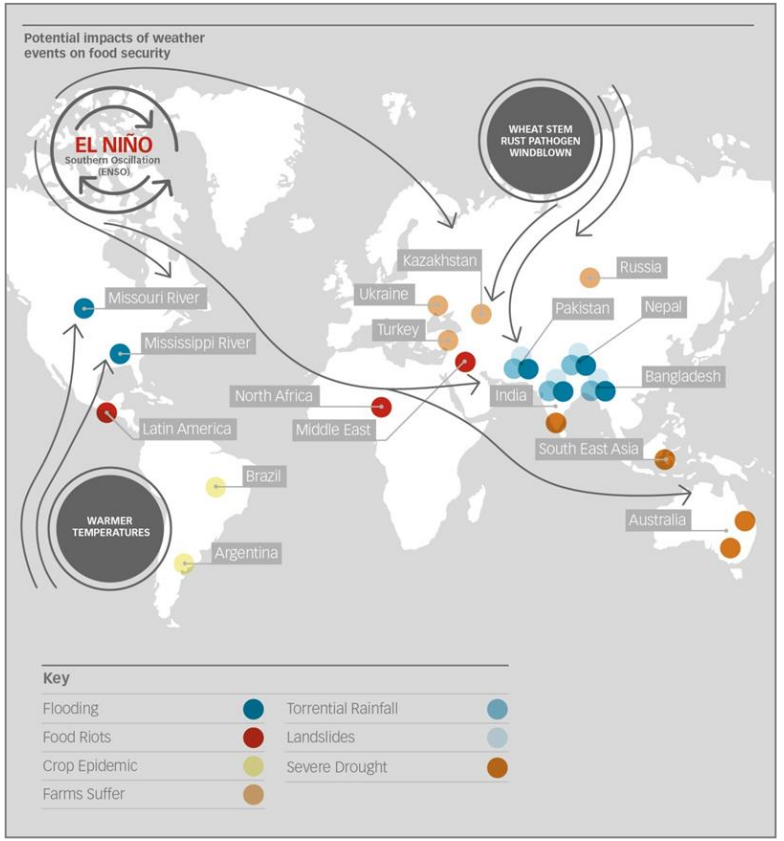
Raise awareness

Some risks are not accepted (yet) as finance or insurance relevant

By describing a scenario (backed by Science) we can raise awareness of the risk;

Scenarios are stories;

Helps to fill availability bias gap



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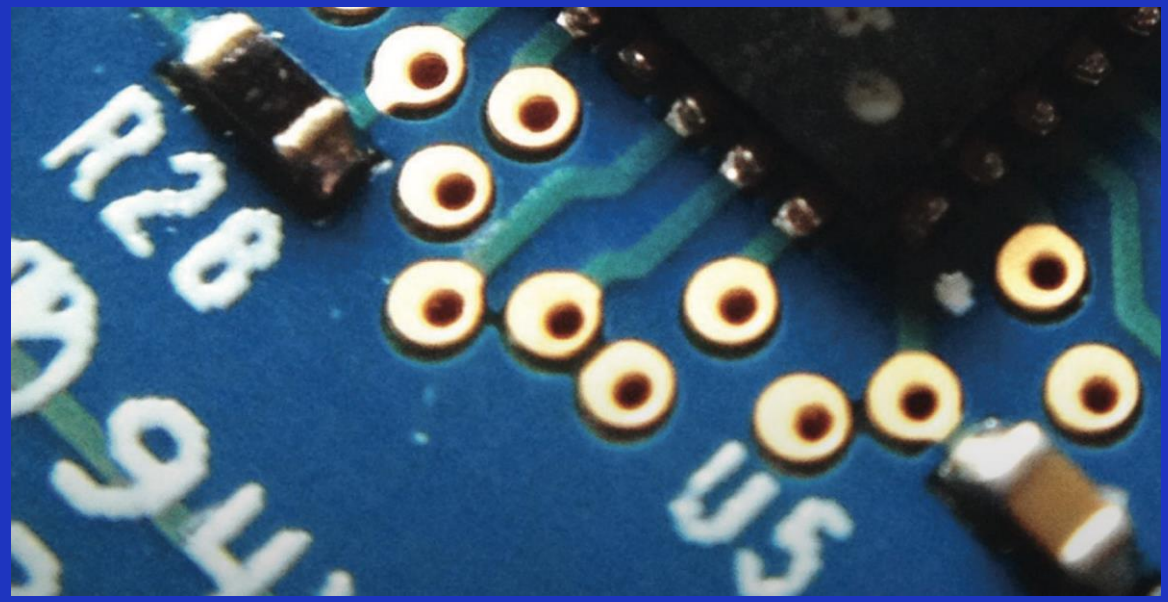
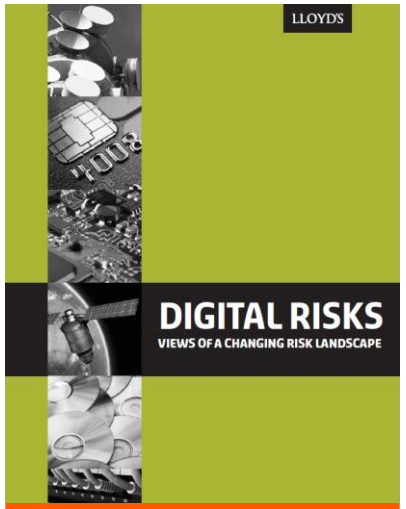
Example: Cyber risks



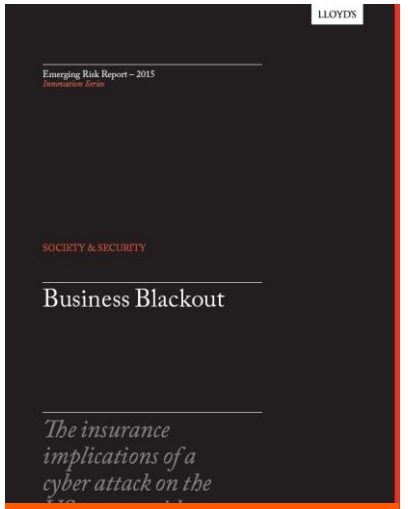
Our digital world

Lloyd's thought leadership catalogue

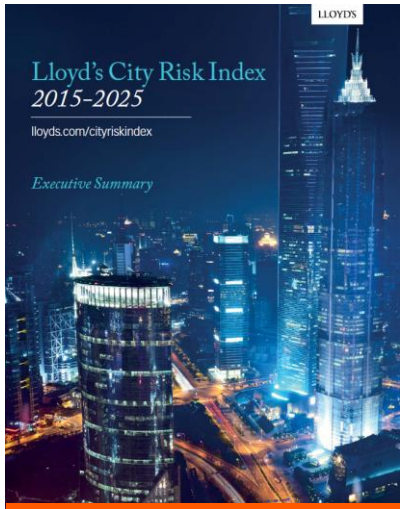


2009

2010



2015



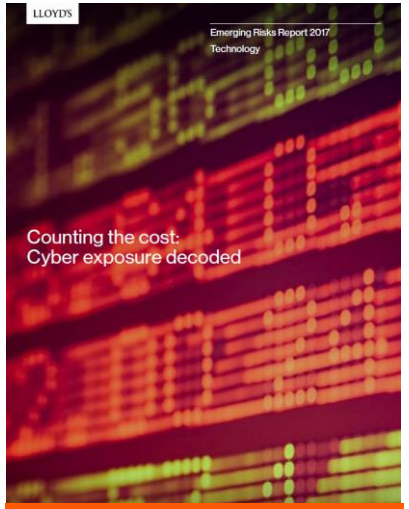
2015

2016

2016

2016

2017



2017

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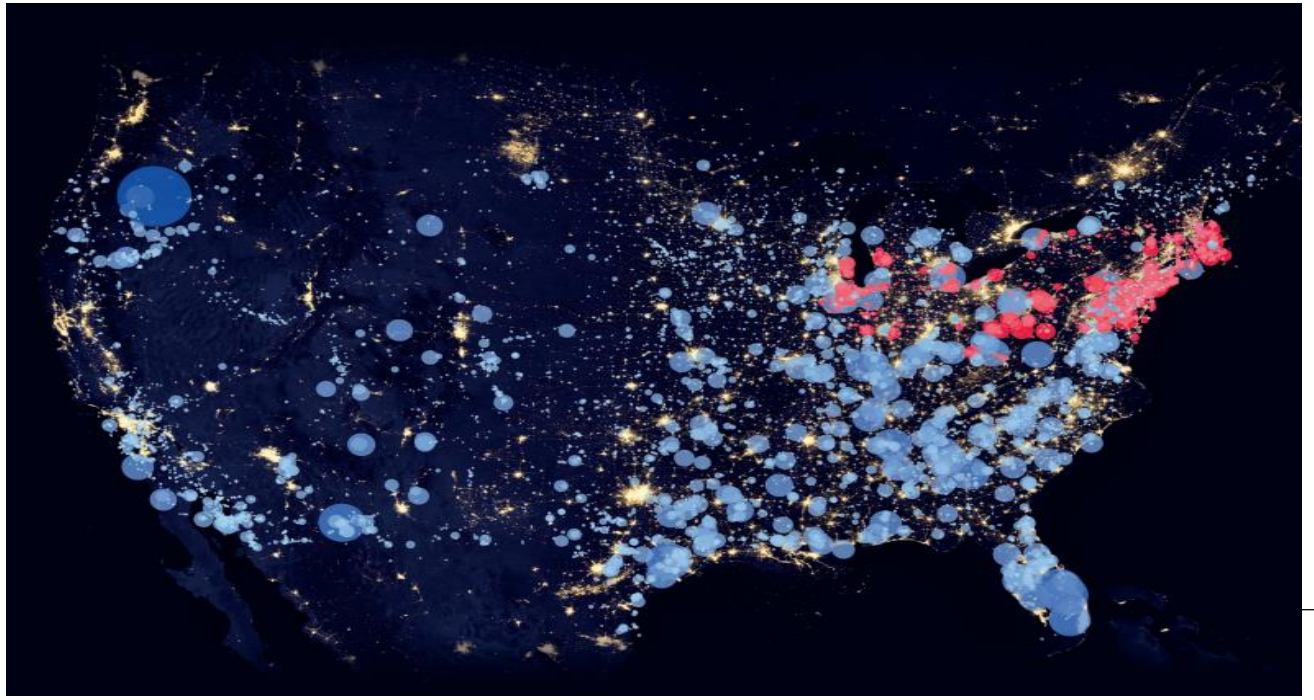
Business Blackout

www.lloyds.com/businessblackout

Year 1 | Year 2 | Year 3+

Research → Dormancy → Activation → Blackout → Aftermath



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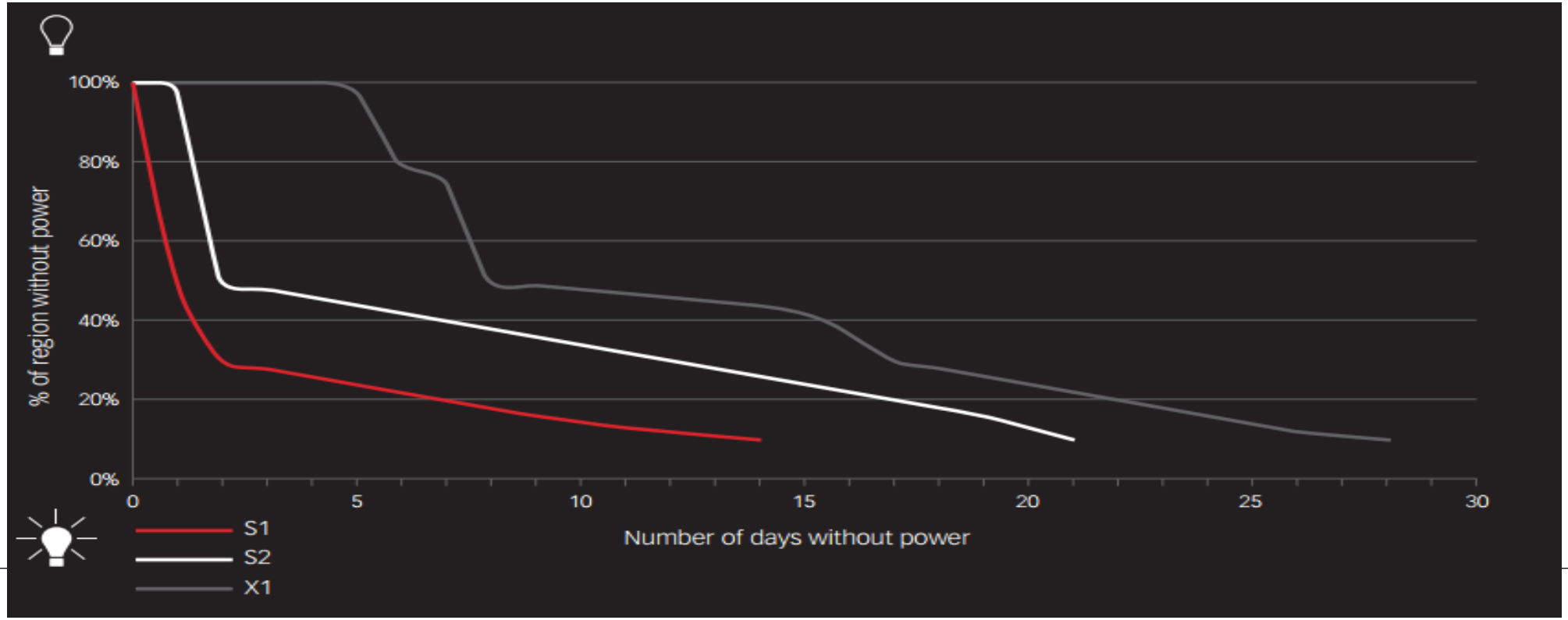
Business Blackout

Scenario	Outage duration, weeks (to 90% restoration)	City-Days	Number of damaged generators	Percentage of generators vulnerable to contagion
S1	2	3.78	50	10%
S2	3	8.08	50	10%
X1	4	13.83	100	20%



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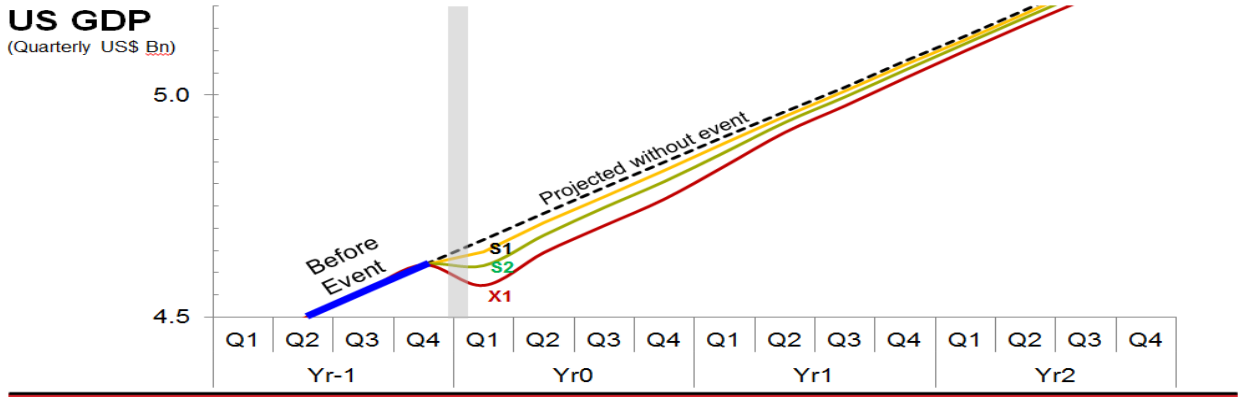
Business Blackout



Scenario Variant	Outage Duration (to 90% reconnectn)	Consumption	Labour	Exports	Confidence	GDP@Risk (5 Yr)
S1	2 Weeks	0.6%	0.6%	1.3%	5%	**$243 Bn**
S2	3 Weeks	1.3%	1.3%	2.8%	10%	**$544 Bn**
X1	4 Weeks	2.2%	2.2%	4.9%	20%	**$1,024 Bn**

Shocks are a proportion of total US output over 1Q

Insurance claims

Power Generation Companies	$ millions
Property Damage (Generators)	633
Business Interruption (Generator Damage)	3,817
Incident Response Costs	3
Fines - FERC/NERC	4
Other liabilities	-
Defendant Companies	
Liability	2,253
Companies that Lose Power	
Perishable Contents	595
Contingent Business Interruption - Suppliers Extension	6,769
Liability	3,120
Companies Indirectly Affected	
Contingent Business Interruption - Critical Vendor	2,928
Liability	749
Homeowners	
Household Contents	465
Specialty	
Event Cancellation	63
Total	**$ 21,398**

For variant S1

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CYENCE

Counting the cost:
decoding cyber exposure

A collaboration between Lloyd's and Cyence

July 2017

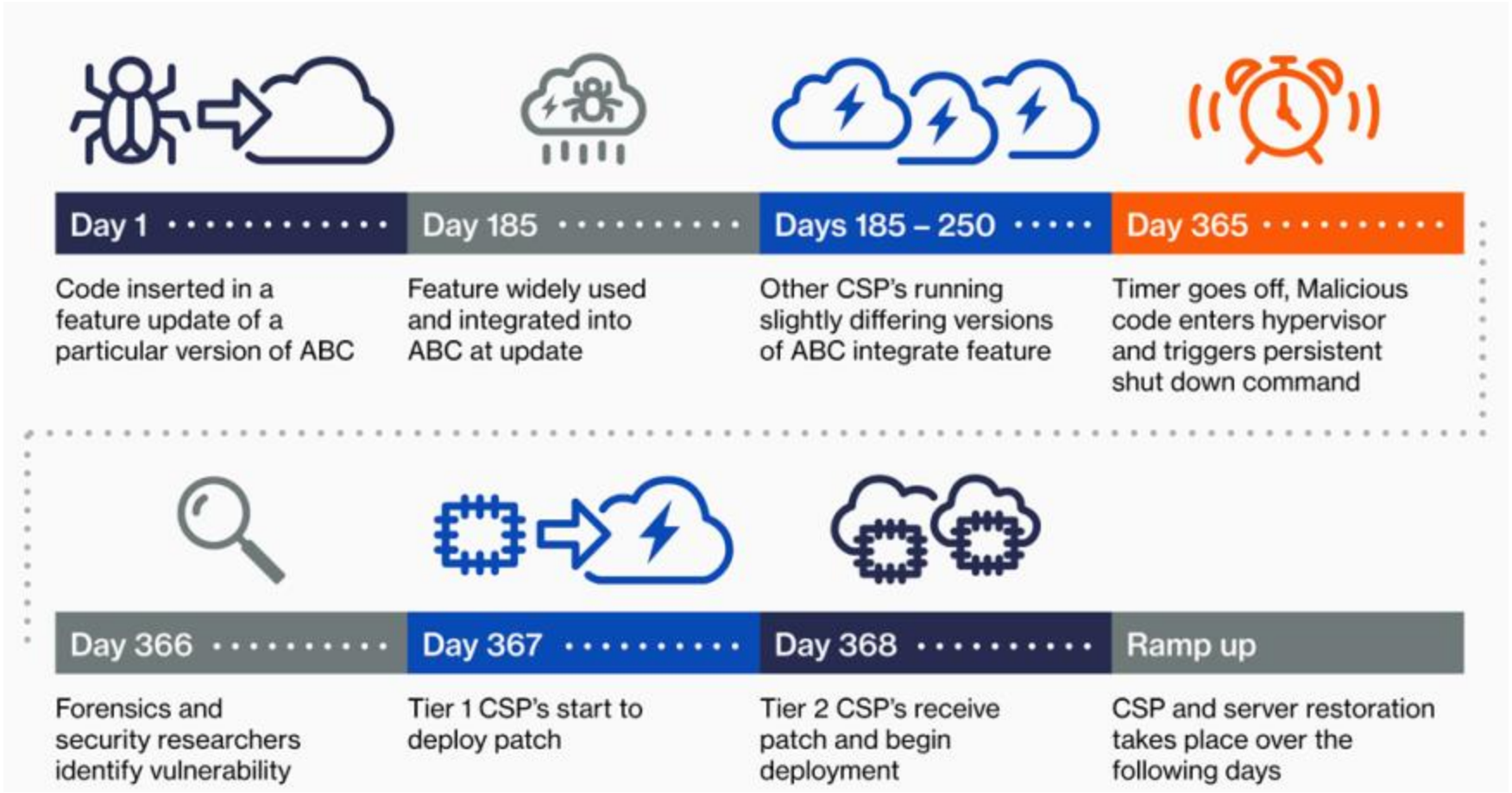

Day 1
Code inserted in a feature update of a particular version of ABC
Day 185
Feature widely used and integrated into ABC at update
Days 185 – 250
Other CSP's running slightly differing versions of ABC integrate feature
Day 365
Timer goes off, Malicious code enters hypervisor and triggers persistent shut down command
Day 366
Forensics and security researchers identify vulnerability
Day 367
Tier 1 CSP's start to deploy patch
Day 368
Tier 2 CSP's receive patch and begin deployment
Ramp up
CSP and server restoration takes place over the following days

Table 4: Return period losses for cloud service provider outage

Sector	% of all businesses analysed (including those that are uninsured)	Return period losses (US Dollars)	
		Large loss	Extreme loss
Financial services	10%	$1.29bn	$16.72bn
Software and tech services	4%	$214m	$1.79bn
Hospitality / Retail trade	11%	$332m	$3.08bn
Healthcare	3%	$60m	$853m
Other	72%	$2.70bn	$30.60bn
All industries	**100%**	**$4.60bn** *95% CI: ($1.60bn-$10.85bn)*	**$53.05bn** *95% CI: ($15.62bn-$121.41bn)*
Duration		**12-18 hours**	**2.5-3 days**

Demystifying uncertainty…

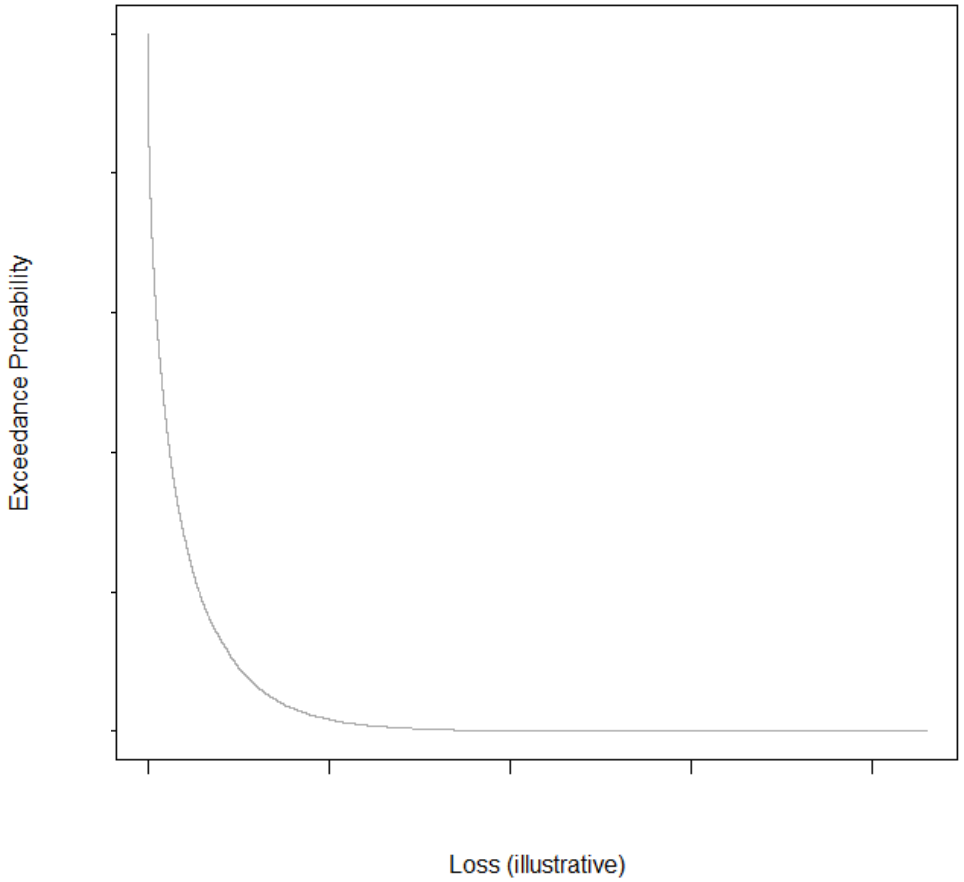
Uncertainty around aggregating cyber losses means the actual figure could be much higher or lower than expected

Optimistic
$15bn

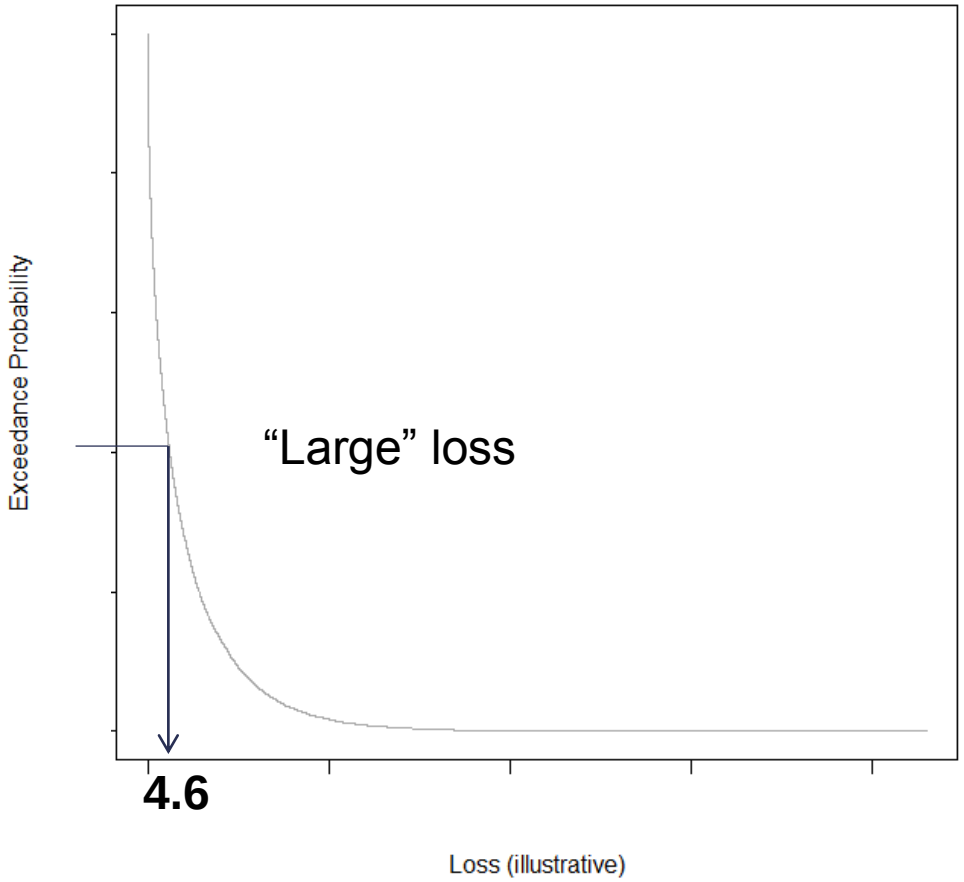
Expected loss
$53bn

Pessimistic
$121bn

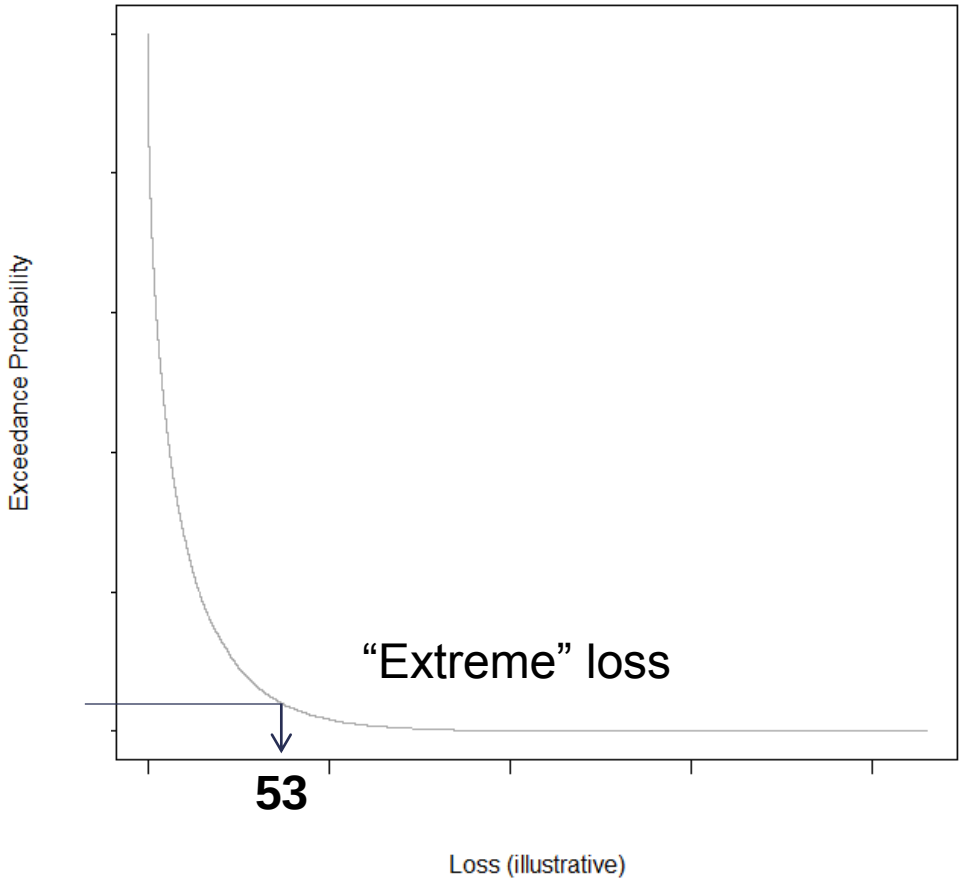
Uncertainty



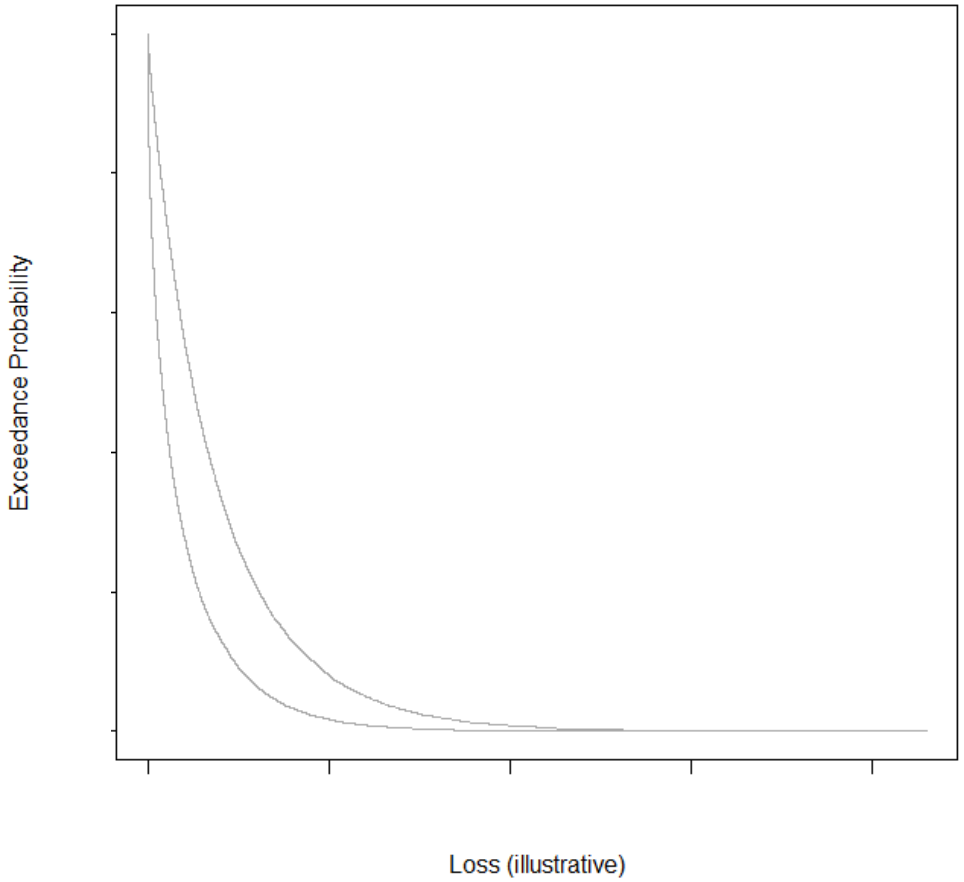
Uncertainty



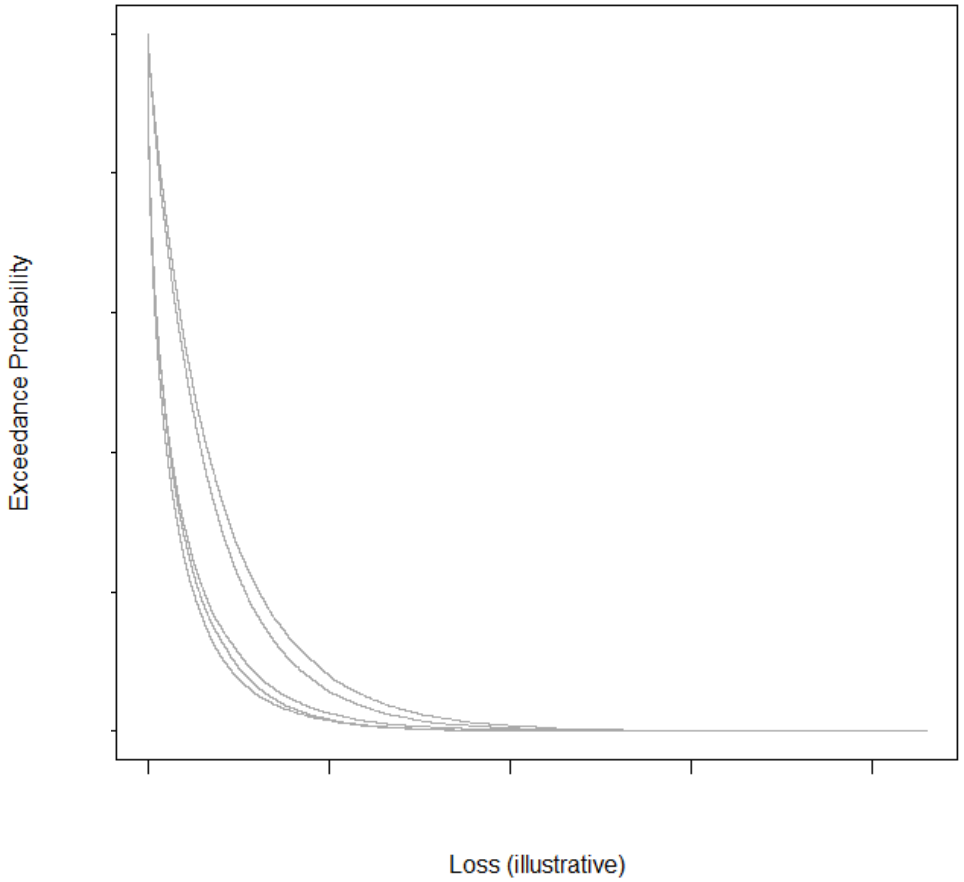
Uncertainty



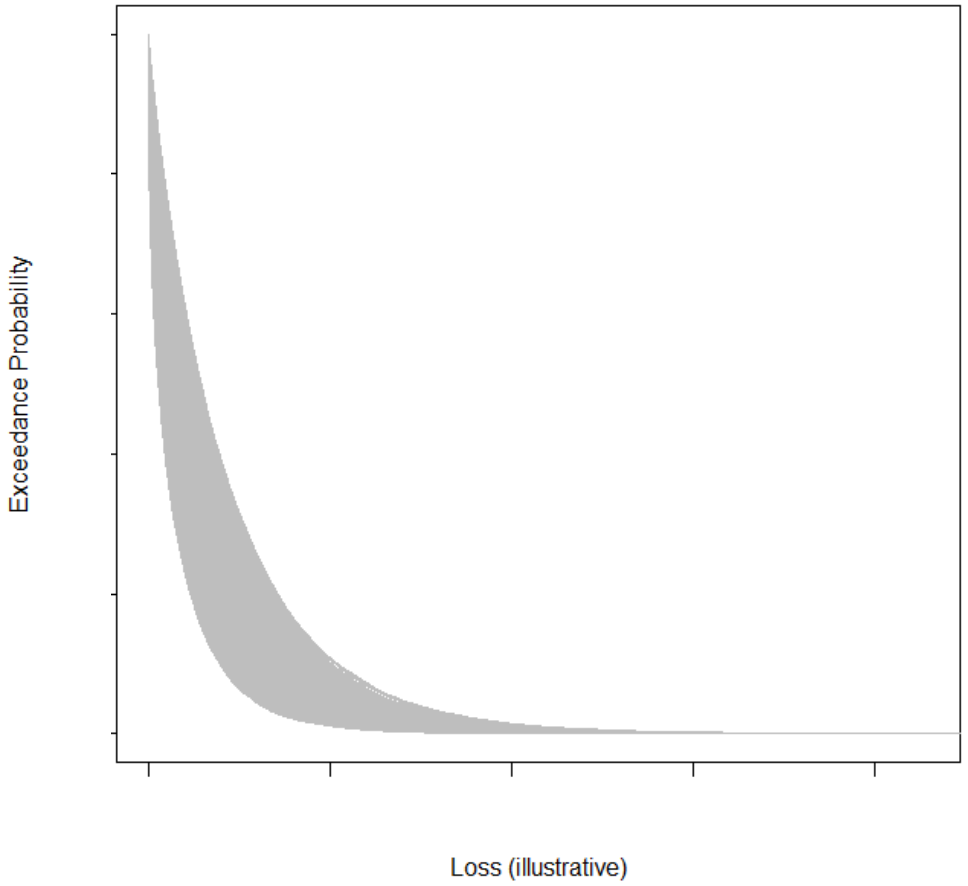
Uncertainty



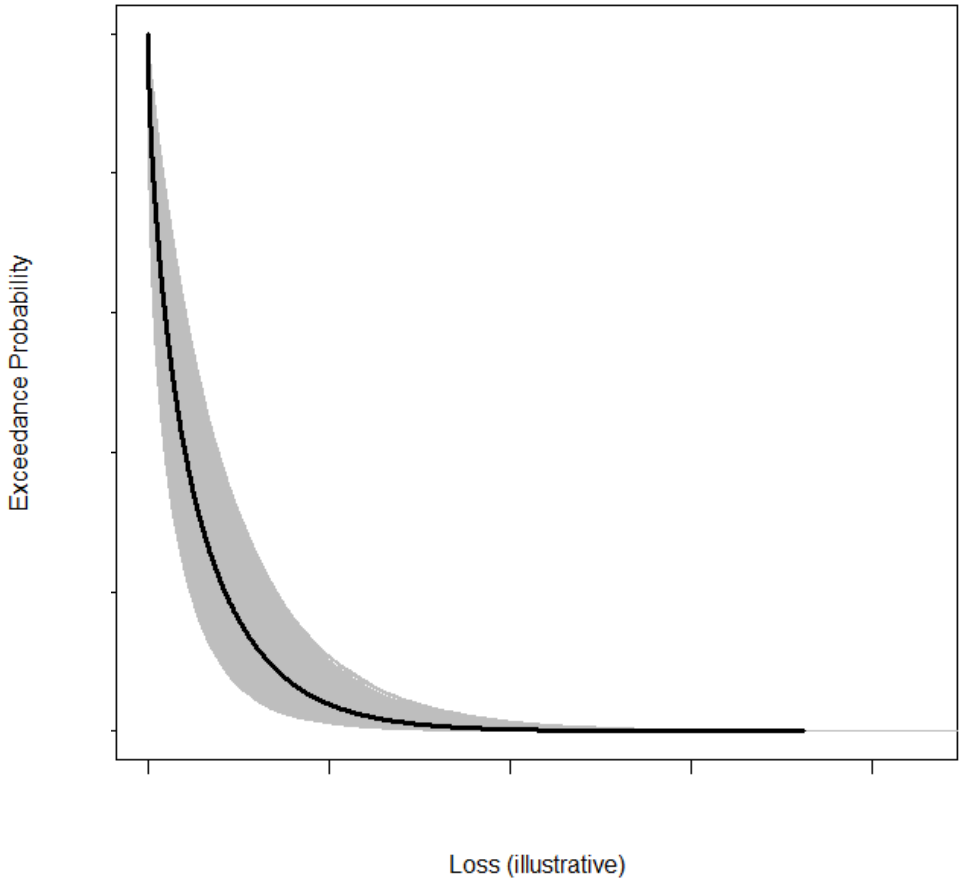
Uncertainty



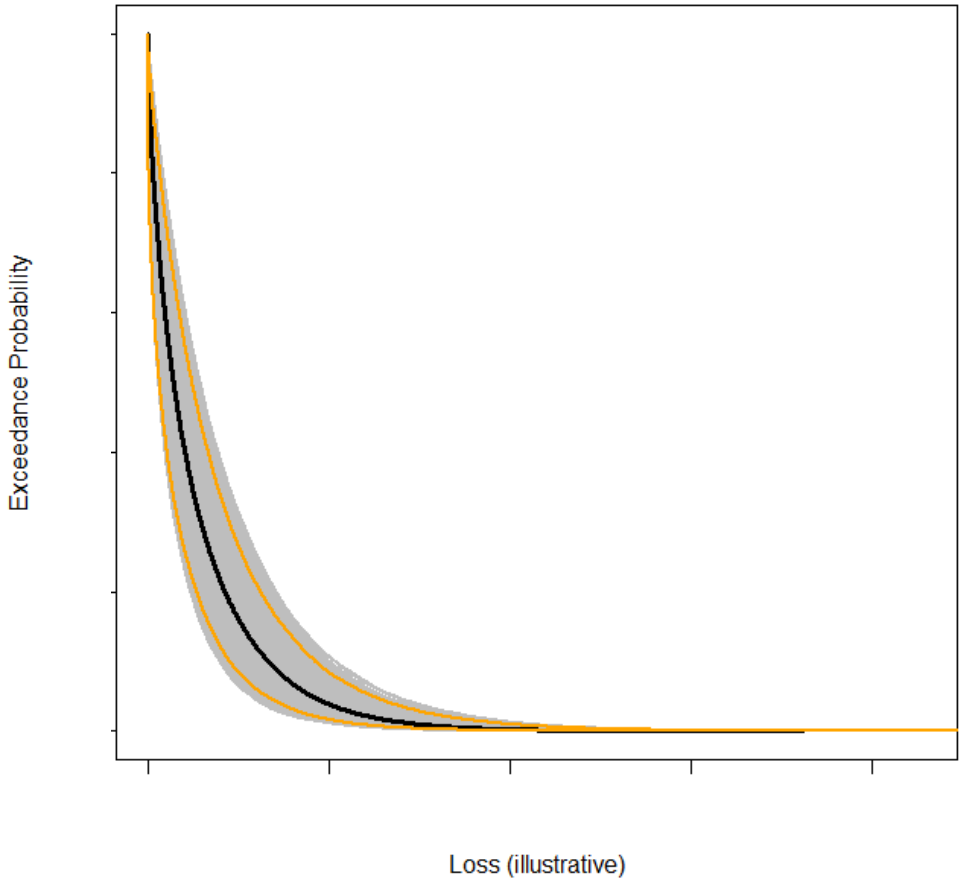
Uncertainty



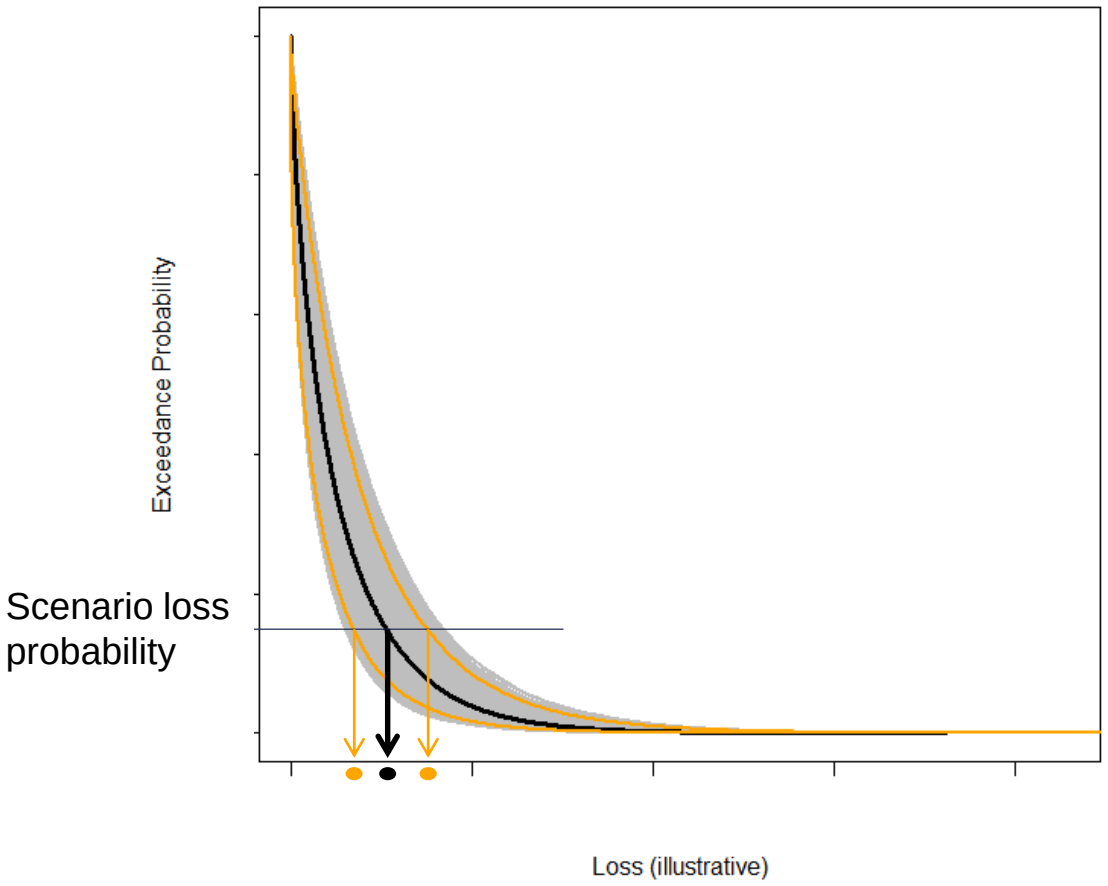
Uncertainty

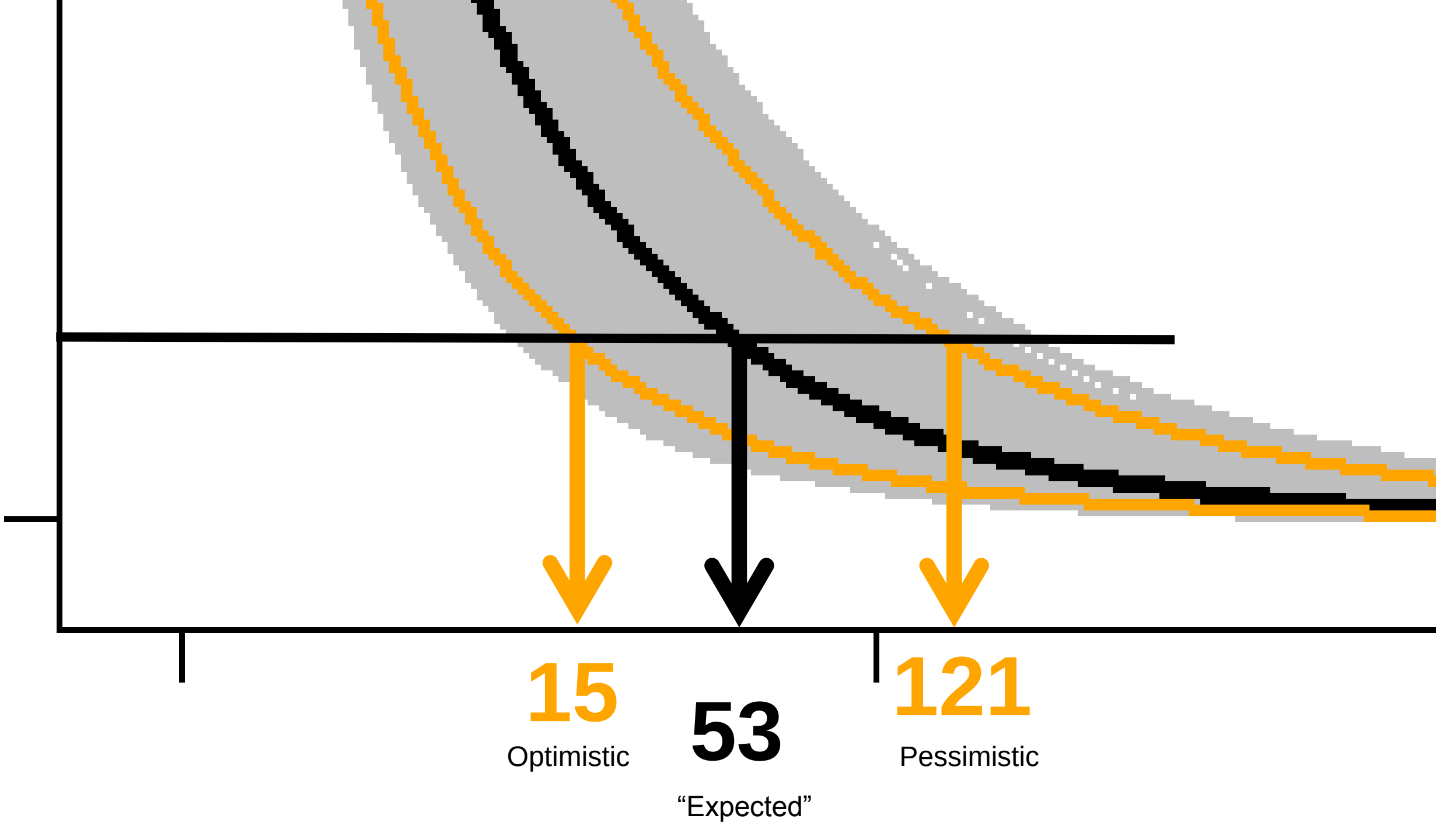


Uncertainty



Uncertainty




15
Optimistic
53
“Expected”
121
Pessimistic

Demystifying uncertainty…

Uncertainty around aggregating cyber losses means the actual figure could be much higher or lower than expected

Optimistic
$15bn

Expected loss
$53bn

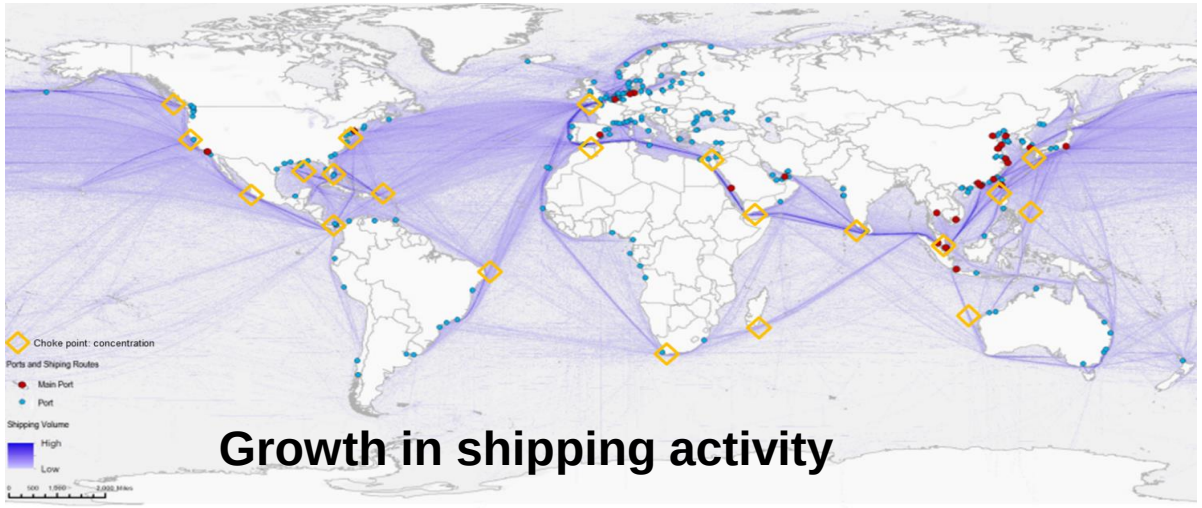
Pessimistic
$121bn

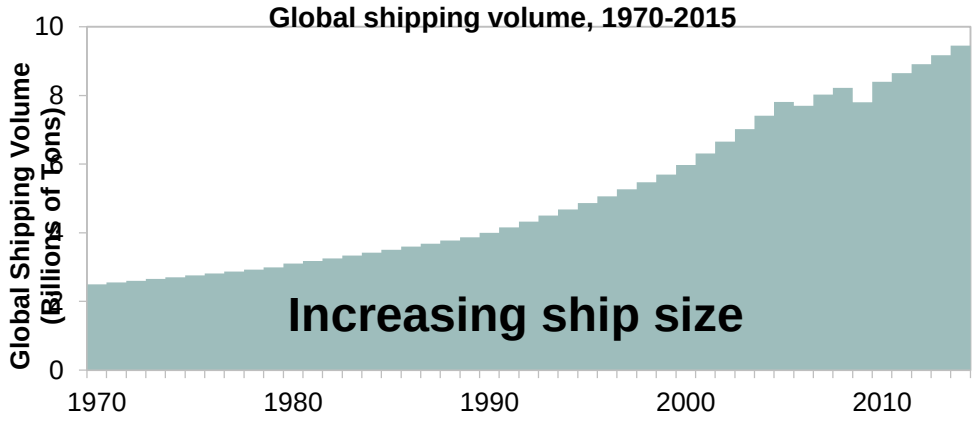
LLOYD'S

Example: Marine

Trends in the marine sector

Emerging challenges for marine insurance





Changes in the regulatory environment

Reaction to trends

- In 2016 Lloyd's changed its Marine RDS
  - Collision in US waters between a cruise vessel with 2,000 passengers and 800 staff and crew, and a fully-laden tanker of greater than 50,000 DWT with 20 crew
  - Sinking of a US-owned cruise vessel with 4,000 passengers and 1,500 staff and crew
- And carried out a marine total loss study:
  - explore emerging trends and risks in marine insurance
  - validate current RDS and
  - consider methods for the next generation of RDS
  - explore the tail risk of extreme loss potential for marine insurers
  - develop an approach to populating a probabilistic event set or exceedance probability curve for a marine insurer
  - provide a tool for insurers to use in assessing their own Probable Maximum Losses (PML)

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Example: Counterfactual risk analysis


Taxi lane
28R

- 7 July 2017
- At nighttime
- Air Canada 759 almost lands on taxi lane
- 4 fully loaded and fuelled planes
  - 1000 passengers in all
- Various planes attempted to warn them
- ACA 759 was just 58ft above ground
- 5 seconds from hitting UAL863

18 AVIATION COLLISION

Assume a collision between two aircraft over a major city, anywhere in the world, using the syndicate's two highest airline exposures. Assume a total liability loss of up to USD4bn: comprising up to USD2bn per airline and any balance up to USD1bn from a major product manufacturer's product liability policy(ies) and/or an air traffic control liability policy(ies), where applicable.

Consideration should be given to other exposures on the ground.

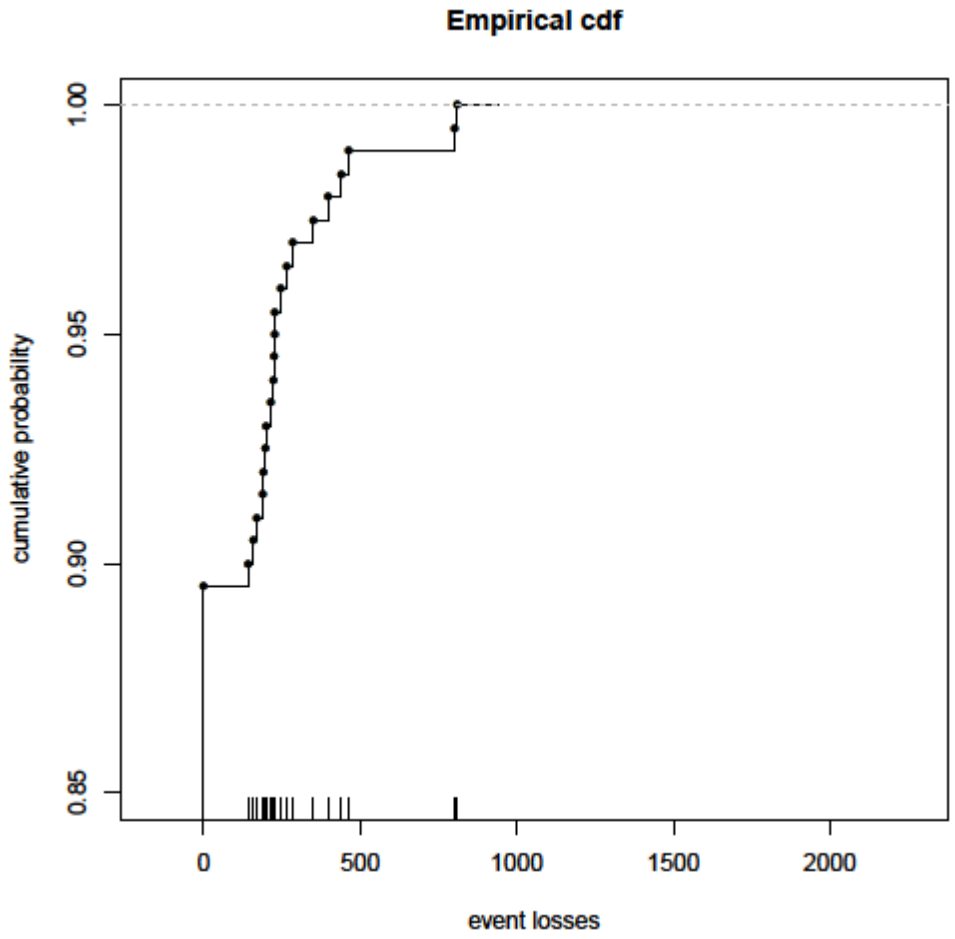
Counterfactual thinking

- With thanks to Gordon Woo who is working with us on a report
- Would it have been possible for ACA759 to hit all four planes?
- What is the maximum possible outcome?
- If one plane is hit can others be affected too?
- What was the chance of delaying a few more seconds without acting?
- Do other airports have longer taxi queues?
- What if the planes were more valuable? What is the most value in one taxi queue?

Events

Weight

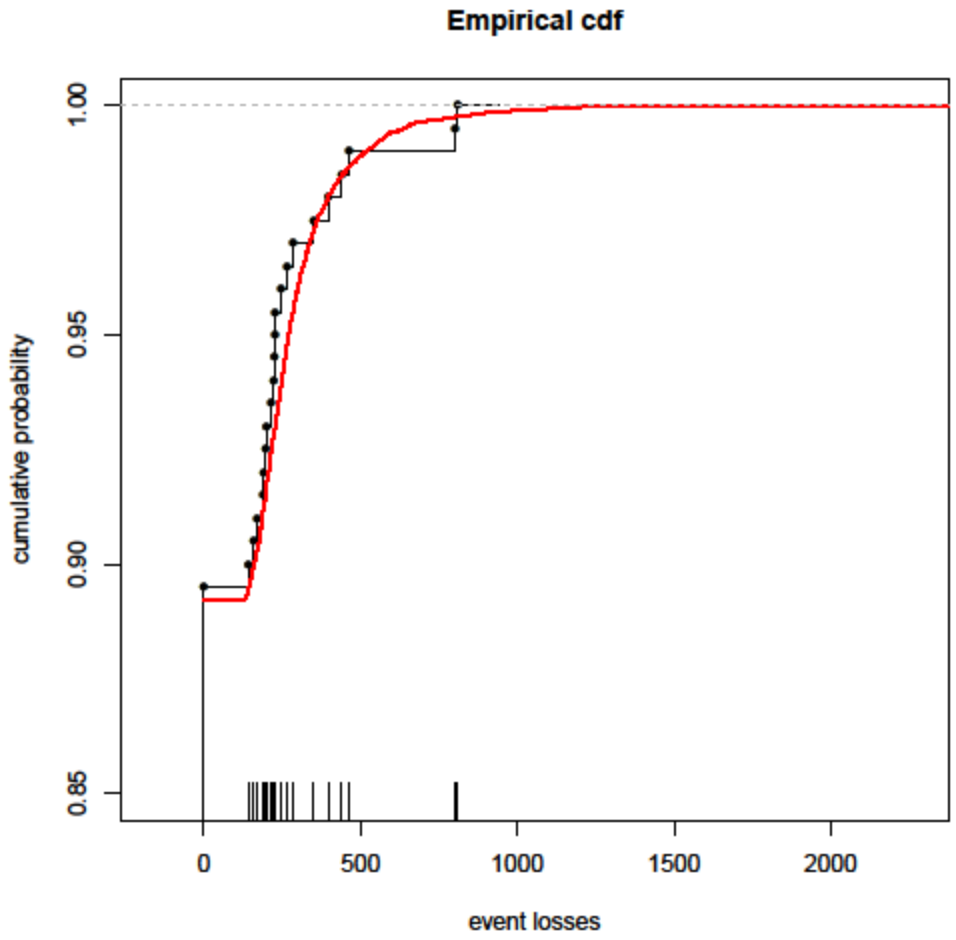
ID	Desc	Loss	W
1	Event 1 description	USD X_1	1/K
2	Event 2 description	USD X_2	
3			
4			
5			
6			
…			
K	Event K description	USD X_K	1/K



Events

Weight

ID	Desc	Loss	W
1	Event 1 description	USD X_1	1/K
2	Event 2 description	USD X_2	
3			
4			
5			
6			
…			
K	Event K description	USD X_K	1/K



Events

ID	Desc	Loss
1	Event 1 description	USD X_1
2	Event 2 description	USD X_2
3		
4		
5		
6		
…		
K	Event K description	USD X_K

Hazards

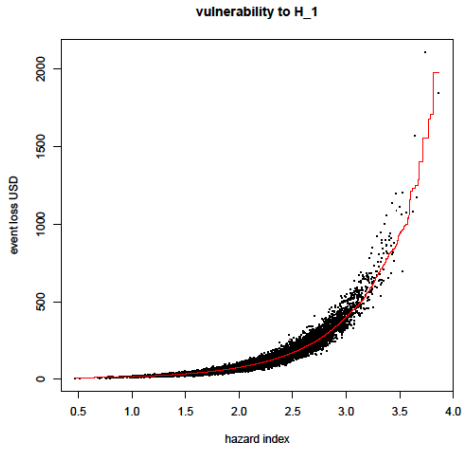
H1	H2	…	H_M
$h_{1,1}$	$h_{1,2}$		$h_{1,M}$
$h_{K,1}$	$h_{K,2}$		$h_{k,M}$

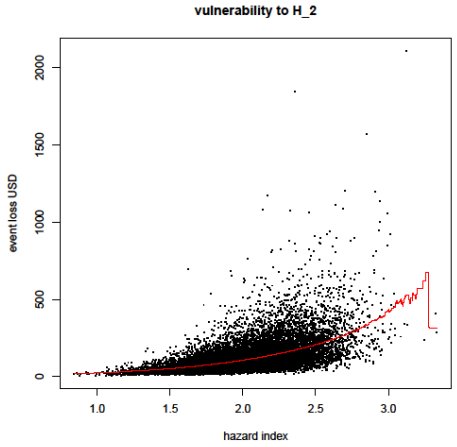
Indicators

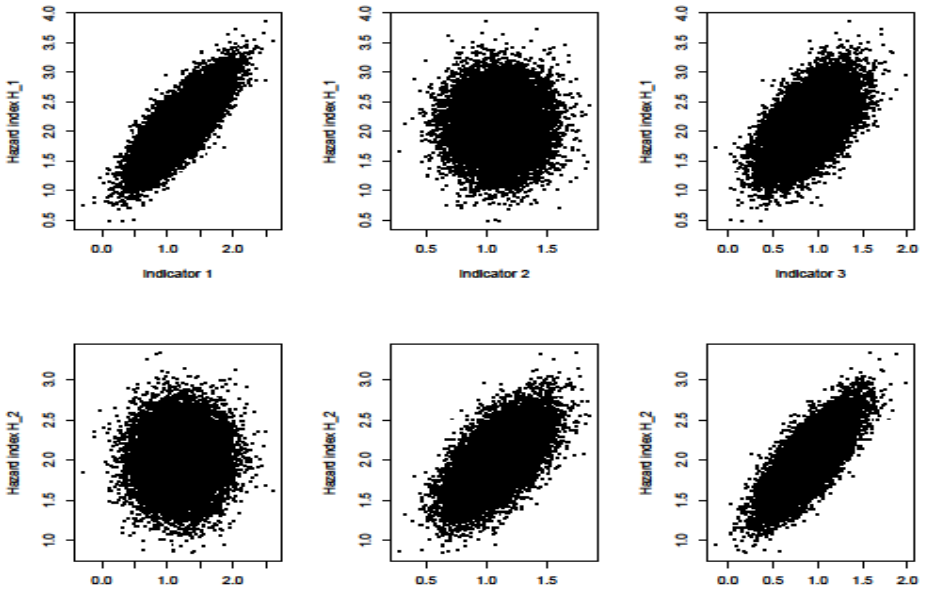
I1	I2	…	I_N
$i_{1,1}$	$i_{1,2}$		$i_{1,N}$
$i_{K,1}$	$i_{K,2}$		$i_{k,N}$

Weight

W
1/K
1/K

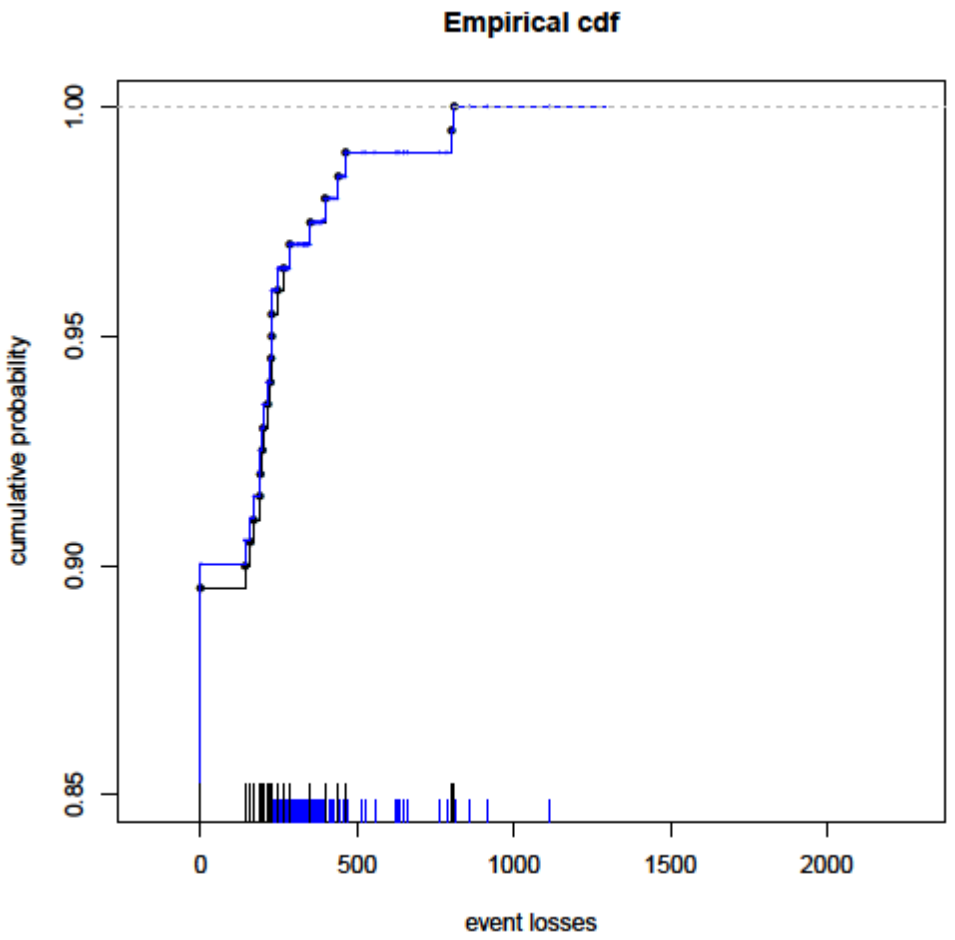






Events			Hazards				Indicators				Weight
ID	Desc	Loss	H1	H2	…	H_M	I1	I2	…	I_N	W
1	Event 1 description	USD X_1,1	$h_{1,1,1}$	$h_{1,2,1}$		$h_{1,M,1}$	$i_{1,1,1}$	$i_{1,2,1}$		$i_{1,N,1}$	1/KP
1		USD X_1,2	$h_{1,1,2}$	$h_{1,2,2}$		$h_{1,M,2}$	$i_{1,1,2}$	$i_{1,2,2}$		$i_{1,N,2}$	1/KP
1		USD X_1,3					$i_{1,1,3}$	$i_{1,2,3}$		$i_{1,N,3}$	1/KP
1		USD X_1,4									1/KP
1		….									1/KP
1		USD X_1,P	$h_{1,1,P}$	$h_{1,2,P}$		$h_{1,M,P}$	$i_{1,1,P}$	$i_{1,2,P}$		$i_{1,N,1,P}$	1/KP
2	Event 2 description	USD X_2									1/K
3											
4											
5											
6											
…											
K	Event K description	USD X_K	$h_{K,1}$	$h_{K,2}$		$h_{k,M}$	$i_{K,1}$	$i_{K,2}$		$i_{k,N}$	1/K

Events			Hazards				Indicators				Weight
ID	Desc	Loss	H1	H2	…	H_M	I1	I2	…	I_N	W
1	Event 1 description	USD X_1,1	$h_{1,1,1}$	$h_{1,2,1}$		$h_{1,M,1}$	$i_{1,1,1}$	$i_{1,2,1}$		$i_{1,N,1}$	1/KP
1		USD X_1,2	$h_{1,1,2}$	$h_{1,2,2}$		$h_{1,M,2}$	$i_{1,1,2}$	$i_{1,2,2}$		$i_{1,N,2}$	1/KP
1		USD X_1,3					$i_{1,1,3}$	$i_{1,2,3}$		$i_{1,N,3}$	1/KP
1		USD X_1,4									1/KP
1		….									1/KP
1		USD X_1,P	$h_{1,1,P}$	$h_{1,2,P}$		$h_{1,M,P}$	$i_{1,1,P}$	$i_{1,2,P}$		$i_{1,N,1,P}$	1/KP
2	Event 2 description	USD X_2									1/K
3											
4											
5											
6											
…											
K	Event K description	USD X_K	$h_{K,1}$	$h_{K,2}$		$h_{k,M}$	$i_{K,1}$	$i_{K,2}$		$i_{k,N}$	1/K



LLOYD'S

In summary

Scenarios are used in many aspects of our oversight

We aim to innovate these methods

— Communicating uncertainty

— Probability tree analysis

— Counterfactual thinking