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# REINSURANCE OF INSURANCE RISK

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Reinsurance of Insurance Risk

# Definition and Purpose

## Definition and Purpose of Reinsurance

# Sources:

- Swiss Re: <http://www.swissre.com/publications/>
  - [An Introduction to Reinsurance](#)
  - [Introduction to Reinsurance Accounting](#)
- Casualty Actuarial Society: <http://casact.org/>
- Czech Statistical Society:  
<http://www.statspol.cz/robust/robust2004/cipra.pdf>
- Printed publications:
  - Cipra, T.: Zajištění a přenos rizik v pojišťovnictví. Grada, Praha (2004)
  - Clark, D.: Basics of Reinsurance Pricing. FCAS, (1996)

# Definition

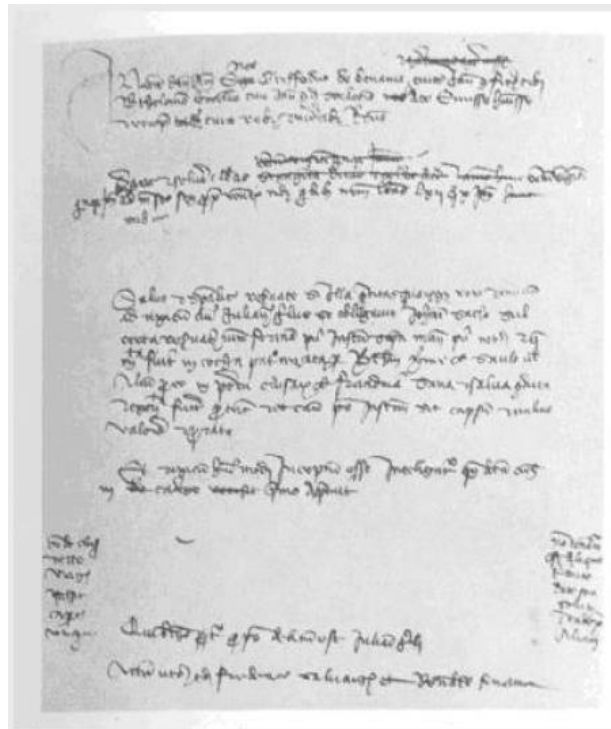
**Reinsurance = insurance for insurance companies**

Reinsurance is the transfer of part of the hazards or risks that a direct insurer assumes by way of insurance contract or legal provision on behalf of an insured, to a second insurance carrier, the reinsurer, who has no direct contractual relationship with the insured

## Definition and Purpose of Reinsurance

# Origins

- First contract with reinsurance characteristics
  - July 12th, 1370 (period of The Hundred Years War)
  - goods shipment from Genoa (Italy) to Bruges (Belgium)



## Definition and Purpose of Reinsurance

# Origins

First reinsurance only company Cologne Re (founded in 1846) as consequence of the catastrophic fire in Hamburg in 1842

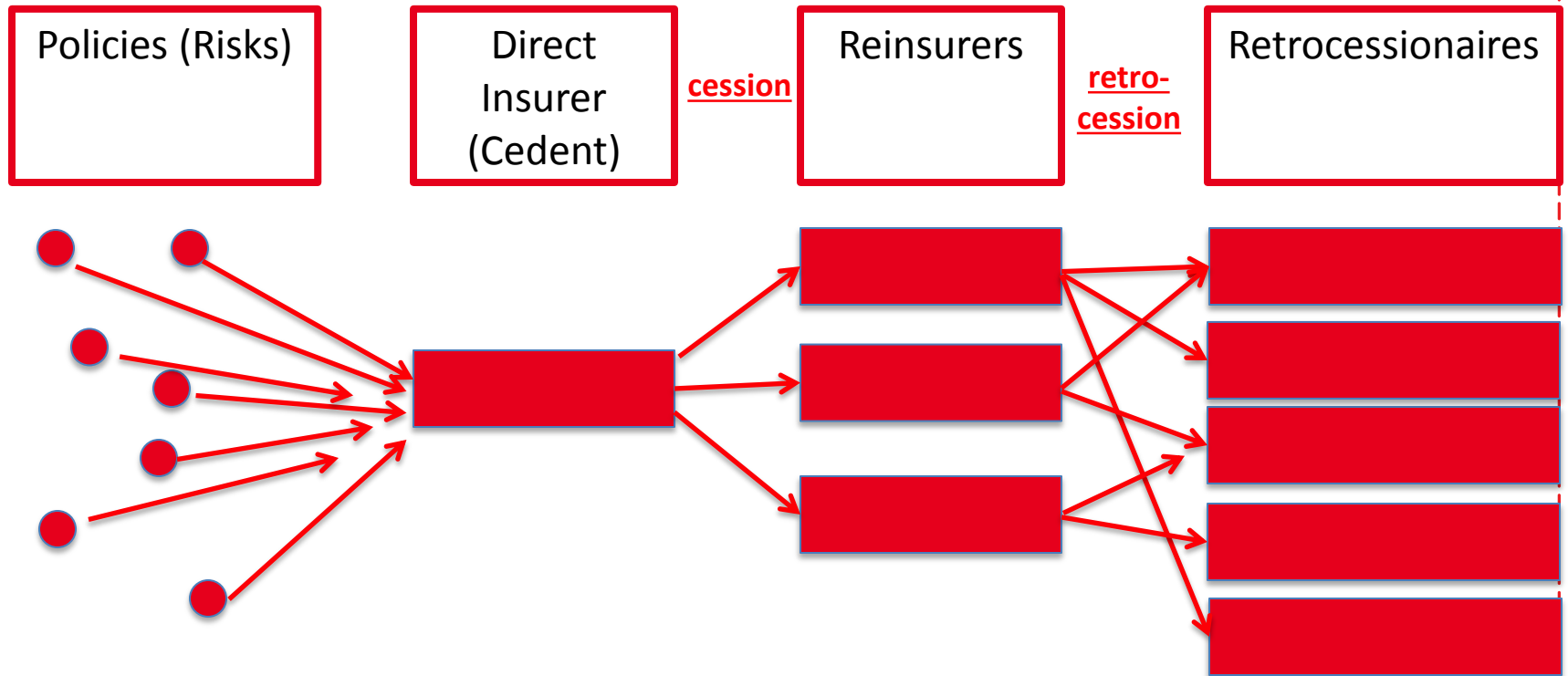
Further:

- 1846: Cologne Re
- 1853: Aachen Re
- 1857: Frankfurt Re
- **1863: Swiss Re**
- **1880: Munich Re**
- 1886: Frankona Re

Today about 200 professional reinsurers worldwide and large number of direct insurers writing also reinsurance

## Definition and Purpose of Reinsurance

# Sharing the Risks





## Definition and Purpose of Reinsurance

# Economic losses in USD billion and as a % of global GDP, 2016

Regions	USD bn*	% of GDP
North America	59	0.29%
Latin America & Caribbean	6	0.14%
Europe	16	0.08%
Africa	3	0.14%
Asia	83	0.32%
Oceania/Australia	6	0.45%
Seas/space	1	
<b>Total</b>	<b>175</b>	
<b>World total</b>		<b>0.24%</b>
10-year average **	175	0.24%

\* rounded

\*\* inflation adjusted

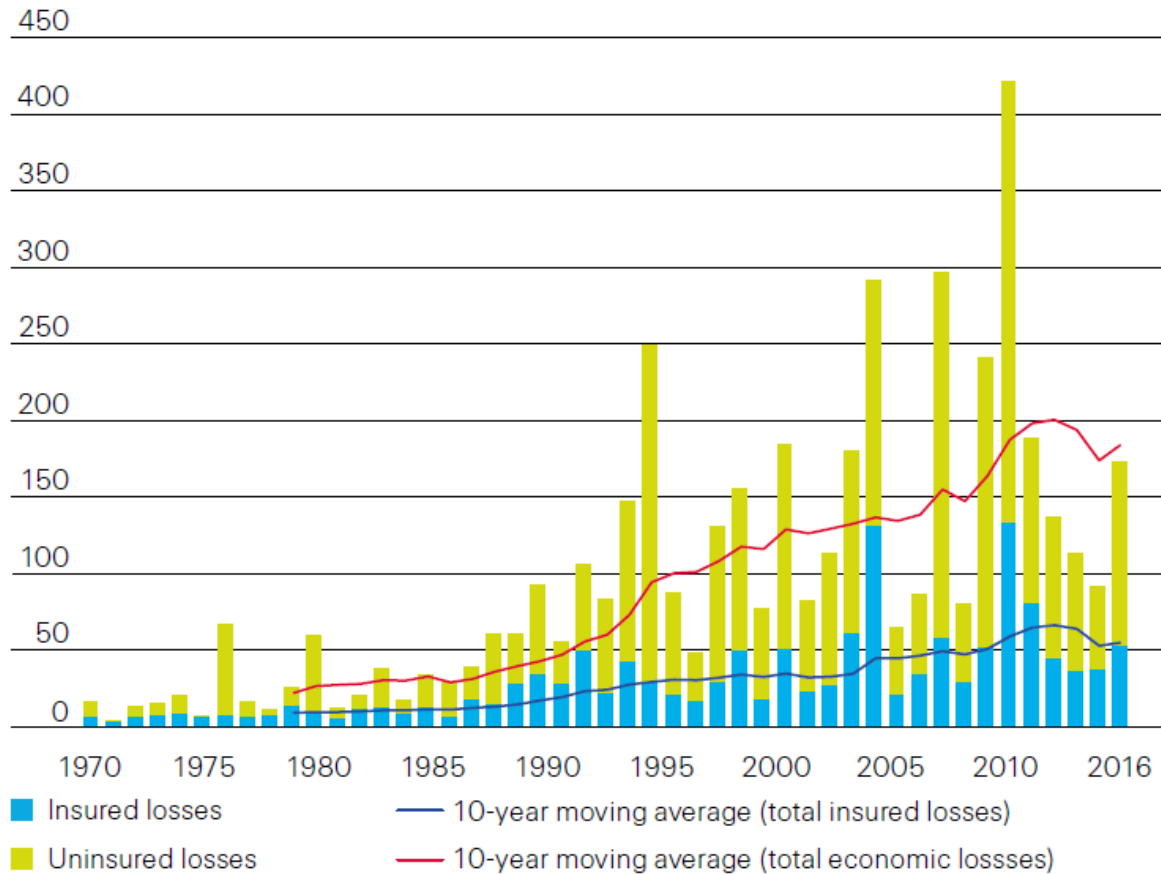
Source: Swiss Re Institute.

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Losses of USD 175 billion from natural catastrophes and man-made disasters, USD 166 billion from natural catastrophes only.

## Definition and Purpose of Reinsurance

# Insured vs uninsured losses 1970 -2016 (in USD billion, at 2016 prices)

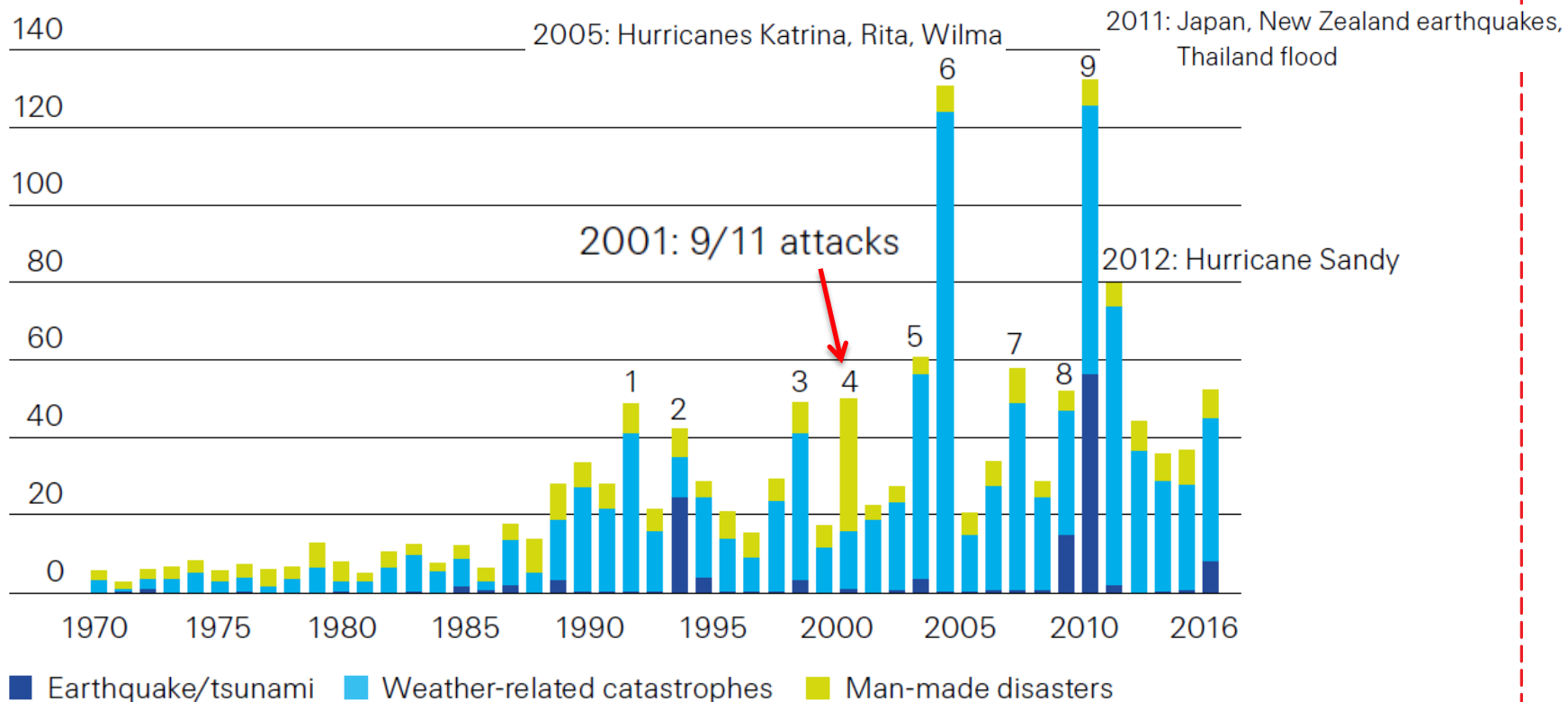


Economic losses = insured + uninsured losses

Source: Cat Perils and Swiss Re Institute.

## Definition and Purpose of Reinsurance

# Insured Catastrophe Losses 1970 -2016 (in USD billion, at 2016 prices)



Source: Cat Perils and Swiss Re Institute.

# Purpose

- Protection against large single losses and catastrophes
- Reduces volatility of the financial results
- Underwriting capacity, solvency
- Know-how transfer
- Etc.

Reinsurance of Insurance Risk

# Types of Reinsurance

# Types of Reinsurance I

**Facultative** – each risk considered individually, obligation to neither cede nor to accept

**Obligatory** – group of homogenous risks automatically ceded to the reinsurance treaty

# Types of Reinsurance II

## Proportional

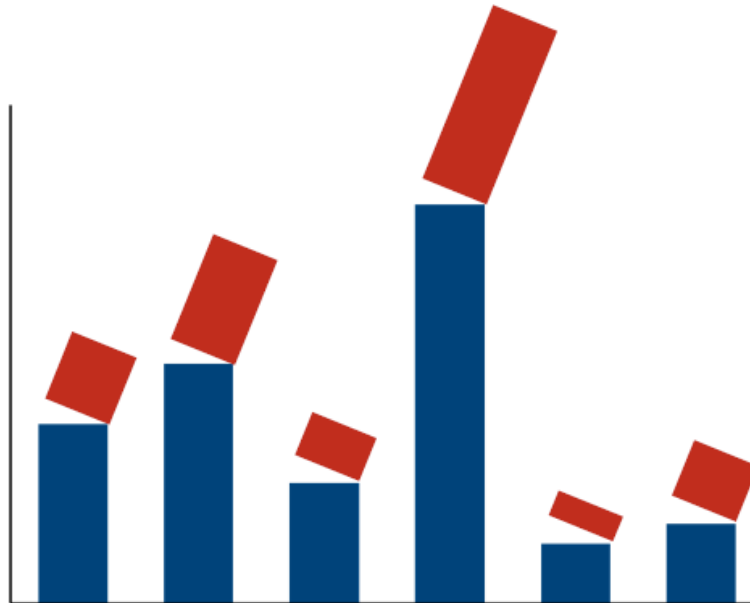
- Quota Share
- Surplus

## Non-Proportional

- Risk XL
- Cat XL
- Stop Loss
- Aggregate XL

# Proportional: Quota Share

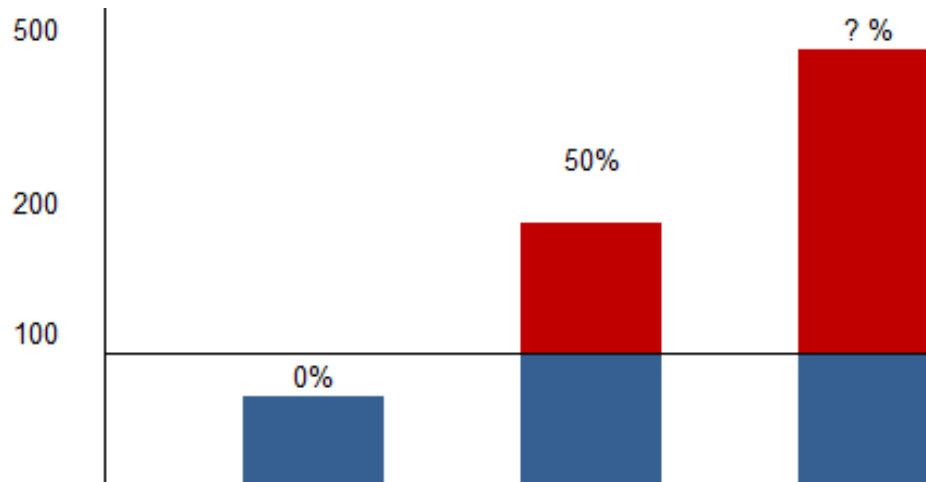
- ceded loss calculated as:  $X_z = q \cdot X$
- ratio  $q$  used also for premium
- commission fixed / sliding scale / profit commission





# Proportional: Surplus

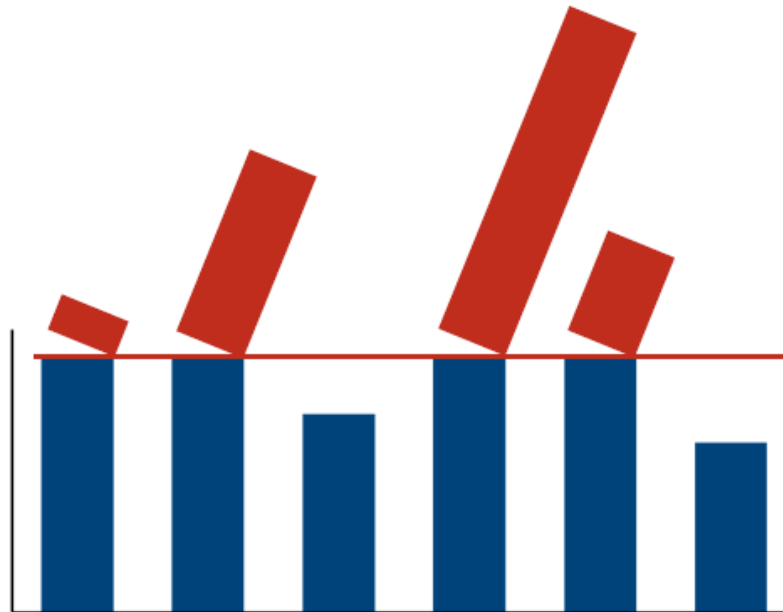
- ceded loss calculated as:  $X_Z = \left(1 - \frac{a}{S}\right) \cdot X$  for  $S > a$
- ratio  $(1-a/S)$  used also for premium
- commission mainly fixed



## Types of Reinsurance

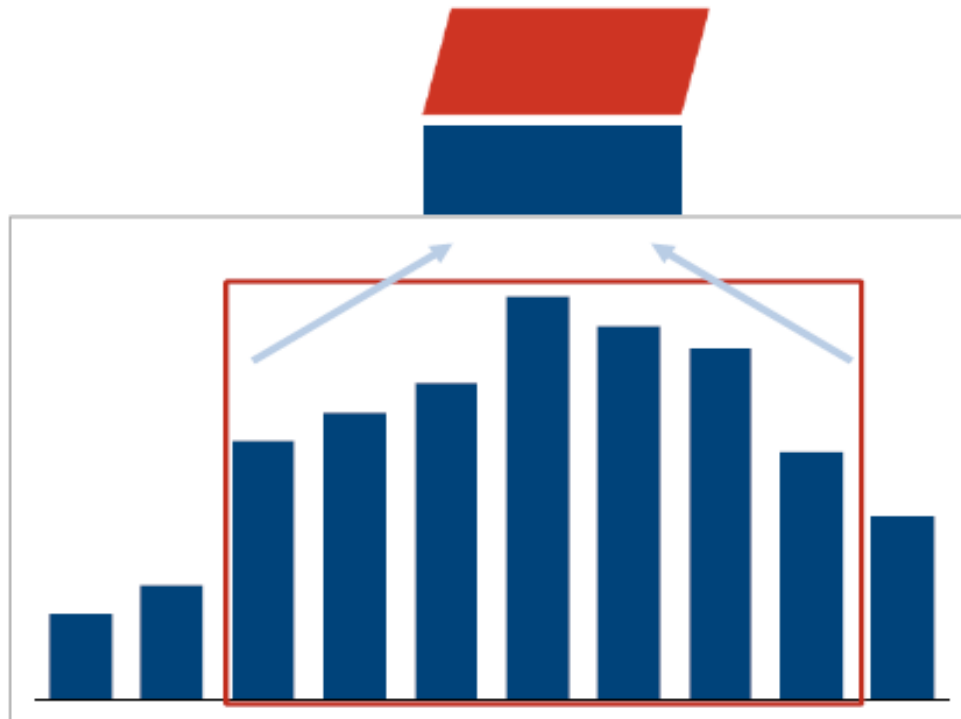
# Non-Proportional: Risk XL

- ceded loss calculated as:  $X_Z = X - a$  for  $X > a$
- premium as % of GNPI
- reinstatements free / paid / combination



# Non-Proportional: Cat XL

- ceded loss calculated as:  $X_z = \sum_{i=1}^n X_i - a$
- premium as % of GNPI
- reinstatements free / paid / combination



## Types of Reinsurance

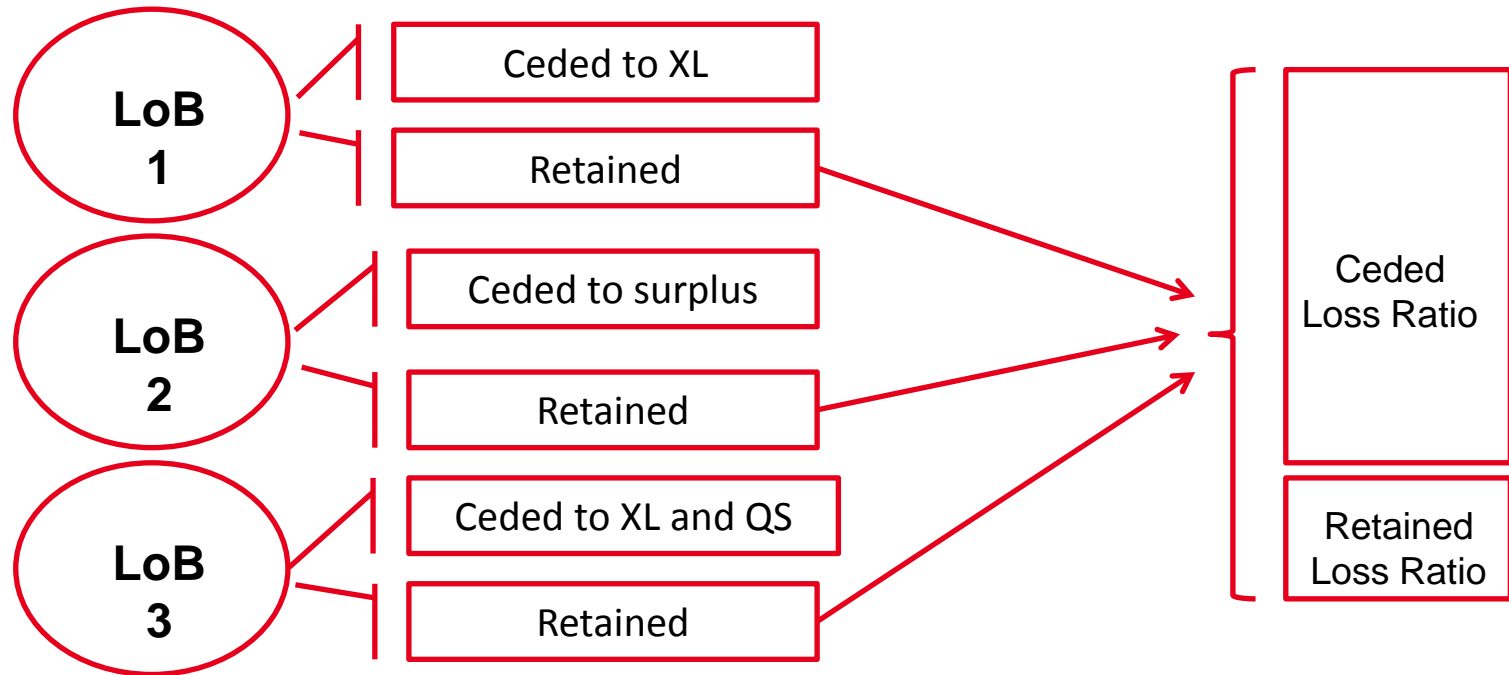
# Non-Proportional: Cat XL



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Source: Internet

# Non-Proportional: Stop Loss



Reinsurance of Insurance Risk

# Reinsurance Program: Example

## Reinsurance Program: Example

# Example of reinsurance program (in CZK)

Line of Business	Type of reinsurance	Layer	Retention	Limit	Rate	Reinstatements
Personal Accident	XL	1	2 000 000	18 000 000	0,65%	1-3@100%
Personal Accident	XL	2	20 000 000	30 000 000	0,16%	1@100%
Motor Liability	XL	1	30 780 000	23 220 000	2,10%	1-15@free
Motor Liability	XL	2	54 000 000	81 000 000	0,80%	1-15@free
Motor Liability	XL	3	135 000 000	Unlimited	0,21%	unlimited@free
Marine Hull	QS	-	100 000 000	100 000 000	-	-
General Liability	XL	1	10 000 000	10 000 000	6,50%	1-30@free
General Liability	XL	2	20 000 000	30 000 000	3,60%	1-20@free
General Liability	XL	3	50 000 000	50 000 000	1,50%	1-10@free
General Liability	XL	4	100 000 000	200 000 000	0,80%	1-5@free
Fire	Surplus	-	100 000 000	1 500 000 000	-	-
Fire	QS	-	50 000 000	50 000 000	-	-
Fire	XL	-	30 000 000	70 000 000	0,39%	1@free; 2-3@50%
Nat Cat	XL	1	270 000 000	630 000 000	1,20%	2@100%
Nat Cat	XL	2	900 000 000	1 100 000 000	0,90%	1@100%
Nat Cat	XL	3	900 000 000	1 500 000 000	0,30%	1@100%
Nat Cat	RPP	-	- fixed price, covering reinstatement premium L1-L2			

## Reinsurance Program: Example

# How much Nat Cat capacity to buy

Cumulative Probability  
Gross Loss OEP for Variation using 'Variation'

Probability	Flood		Wind	
	VaR	TVaR	VaR	TVaR
10,00%	0 Kč	92 100 453 Kč	0 Kč	62 888 459 Kč
20,00%	0 Kč	103 613 009 Kč	0 Kč	70 749 516 Kč
25,00%	0 Kč	110 520 543 Kč	0 Kč	75 466 151 Kč
40,00%	0 Kč	138 150 679 Kč	0 Kč	94 332 688 Kč
50,00%	0 Kč	165 780 815 Kč	0 Kč	113 199 226 Kč
60,00%	0 Kč	207 226 019 Kč	0 Kč	141 499 032 Kč
75,00%	0 Kč	331 561 630 Kč	0 Kč	226 398 452 Kč
80,00%	0 Kč	414 452 037 Kč	0 Kč	282 998 064 Kč
90,00%	0 Kč	828 904 075 Kč	0 Kč	565 996 129 Kč
95,00%	326 151 471 Kč	1 450 309 357 Kč	305 676 614 Kč	935 734 592 Kč
98,00%	679 248 645 Kč	2 944 806 306 Kč	581 149 035 Kč	1 725 909 583 Kč
99,00%	1 177 991 695 Kč	5 011 675 072 Kč	937 160 108 Kč	2 727 620 145 Kč
99,50%	2 025 841 749 Kč	8 504 672 338 Kč	1 505 511 096 Kč	4 293 387 584 Kč
99,60%	2 399 453 285 Kč	10 082 181 293 Kč	1 757 598 808 Kč	4 959 981 064 Kč
99,80%	4 098 337 755 Kč	17 097 671 428 Kč	2 727 738 596 Kč	7 767 233 906 Kč
99,90%	6 772 456 926 Kč	28 997 655 663 Kč	4 307 762 232 Kč	12 168 681 280 Kč
99,99%	39 362 649 701 Kč	170 044 702 742 Kč	19 710 762 320 Kč	49 888 271 767 Kč

SII Internal  
Model?

X

SII Standard  
Formula?



## Reinsurance Program: Example

# How much capacity to buy: non- Nat Cat business?

- Maximise capacity to gain competitive advantage
- Price for „empty capacity“
- Unlimited cover for MTPL

Line of Business	Type of reinsurance	Layer	Retention	Limit	Rate	Reinstatements
Fire	Surplus		-	100 000 000	1 500 000 000	-
Fire	QS		-	50 000 000	50 000 000	-
Fire	XL		-	30 000 000	70 000 000	0,39% 1@free; 2-3@50%

## How to structure the program?

- Define capacity
- What is maximum retention (do any group rules exist?)
- Targets of the company might be:
  - Minimise price
  - Minimise cost of reinsurance (ceded amounts vs. expected recoveries)
  - Minimise volatility of net underwriting result
  - Maximise difference between return on capital and cost of capital
  - Other (financial, cash-flow, etc.)

## Reinsurance Program: Example

# Example of Complex Structure

Line of Business	Type of reinsurance	Layer	Retention	Limit	Rate	Reinstatements
Fire	Surplus	-	100 000 000	1 500 000 000	-	-
Fire	QS	-	50 000 000	50 000 000	-	-
Fire	XL	-	30 000 000	70 000 000	0,39%	1@free; 2-3@50%

- important to know the hierarchy (insurance)
- e.g. SI = 400.000 CZK, gross loss = 200.000
- loss ceded to surplus (in ths.) =  $((400-100)/400) * 200 = 150$
- loss ceded to QS (in ths.) =  $(200 - 150) * 0,5 = 25$
- loss ceded to XL (in ths.) =  $\text{Max}(0; (200 - 150 - 25) - 30) = 0$
- net loss (in ths.) = 25

Reinsurance of Insurance Risk

# Subjects on the Market

# Roles of the Market Subjects

- Insurance Companies
  - reinsurance buyers
- Brokers
  - modelling, structuring, negotiating, administration of treaties
- Reinsurers
  - providing capacity
- Supervisory Authorities

## Subjects on the Market

### Top 25 Global Non-Life Reinsurance Groups

Ranked by gross non-life premium written in 2015 (USD Millions)

2015 Ranking	2014 Ranking	Company	Reinsurance Premiums Written Non-Life Only						Combined Ratios		
			Gross 2015	Net 2015	Gross 2014	Net 2014	Gross % Change	Net % Change	2015	2014	Change
1	2	Swiss Re Ltd.	19,561	19,197	20,288	19,937	-3.6%	-3.7%	87.4	85.4	2.1
2	1	Munich Reinsurance Company	19,319	18,449	20,337	19,632	-5.0%	-6.0%	89.7	92.7	(3.0)
3	3	Lloyd's	12,740	10,237	13,185	10,403	-3.4%	-1.6%	86.7	81.3	5.4
4	5	Hannover Rueckversicherung AG	10,204	8,851	9,607	8,523	6.2%	3.8%	94.7	95.0	(0.3)
5	4	Berkshire Hathaway Inc.	7,049	7,049	9,889	9,889	-28.7%	-28.7%	90.5	92.5	(2.0)
6	6	SCOR S.E.	6,254	5,584	5,999	5,369	4.2%	4.0%	91.1	91.4	(0.3)
7	7	Everest Re Group Ltd.	5,876	5,378	5,749	5,257	2.2%	2.3%	83.4	82.8	0.5
8	9	Korean Reinsurance Company	4,812	3,197	4,837	3,063	-0.5%	4.4%	98.4	99.8	(1.4)
9	8	China Reinsurance (Group) Corporation	4,743	4,652	4,959	4,856	-4.4%	-4.2%	96.0	99.6	(3.6)
10	10	PartnerRe Ltd.	4,277	4,022	4,667	4,500	-8.4%	-10.6%	85.6	86.2	(0.5)
11	11	Transatlantic Holdings, Inc	3,662	3,387	3,600	3,410	1.7%	-0.7%	89.5	89.6	(0.1)
12	12	General Insurance Corporation of India	2,751	2,445	2,403	2,197	14.5%	11.3%	109.7	109.8	(0.1)
13	18	XL Group plc	2,273	2,029	1,785	1,633	27.3%	24.2%	81.0	73.3	7.7
14	14	R+V Versicherung AG	2,136	2,092	2,091	2,057	2.1%	1.7%	98.0	100.3	(2.3)
15	17	The Toa Reinsurance Company, Limited	2,067	1,857	1,979	1,742	4.4%	6.6%	97.5	93.7	3.8
16	13	Axis Capital Holdings Limited	2,021	1,915	2,176	2,127	-7.1%	-10.0%	86.0	81.3	4.7
17	22	RenaissanceRe Holdings Ltd.	2,011	1,416	1,551	1,068	29.7%	32.6%	64.7	50.2	14.5
18	20	MS Amlin plc	1,930	1,588	#N/A	#N/A	#N/A	#N/A	78.2	#N/A	#N/A
19	23	Arch Capital Group Ltd.	1,908	1,504	1,527	1,266	24.9%	18.8%	83.1	73.6	9.5
20	19	MAPFRE RE, Compania de Reaseguros S.A.	1,724	1,508	1,784	1,542	-3.4%	-2.2%	87.9	90.5	(2.5)
21	16	QBE Insurance Group Limited	1,624	1,023	2,035	1,571	-20.2%	-34.9%	83.4	87.8	(4.4)
22	36	Tokio Marine Holdings, Inc.	1,546	1,339	890	716	73.7%	86.9%	92.9	#N/A	#N/A
23	21	Odyssey Re Holdings Corp.	1,496	1,376	1,756	1,616	-14.8%	-14.8%	82.0	79.1	2.9
24	25	MS&AD Insurance Group Holdings, Inc.	1,417	#N/A	1,321	#N/A	7.3%	#N/A	#N/A	#N/A	#N/A
25	24	Caisse Centrale de Reassurance	1,306	1,273	1,488	1,443	-12.2%	-11.8%	63.5	81.3	(17.8)

Sources: AM Best data & research, Sept. 5, 2016; 2014 figures from Sept. 2, 2015 Special Report

Notes: NEP used for Hannover; 2015 and 2014 figures for General Insurance of India, Toa Re are for fiscal year ended Mar. 31

Ratio reported on a gross basis for R+V Versicherung AG



Reinsurance of Insurance Risk

# Renewal Process

# Timeline of Renewal 1.1. xxxx

- May – September: data preparation by insurance companies and submitted to brokers, suitability assessed by brokers / internally
- September – December: data sent to reinsurers who provide their quotes > deciding about final terms and wordings > placement
- December 31st – all treaties need to be placed (rare exceptions possible)



## Renewal Process

# Decision about final terms

			Quoted Rate (as % of GNPI)								
Layer	Limit	Retention	Swiss Re	R+V	Markel	Amlin	Novae	Scor	Aspen	Final?	
1	23 220 000	30 780 000	1,30%	1,10%	0,89%	1,30%	2,00%	1,70%	1,10%	1,1% - 1,3%	
2	81 000 000	54 000 000	0,65%	0,72%	0,59%	0,85%	0,79%	0,60%	0,99%	0,65% - 0,72%	
3	Unlimited	135 000 000	0,26%	0,19%	0,15%	0,21%	0,10%	0,30%	0,26%	0,21% - 0,26%	
			Written line (indication)								
Layer	Limit	Retention	Swiss Re	R+V	Markel	Amlin	Novae	Scor	Aspen	Total	
1	23 220 000	30 780 000	30%	25%	10%	15%	20%	30%	25%	105%	
2	81 000 000	54 000 000	30%	25%	10%	15%	20%	30%	25%	95%	
3	Unlimited	135 000 000	30%	25%	5%	15%	5%	30%	35%	115%	

### Final terms subject to further negotiations:

- not all reinsurers quoted
- offer of a whole package
- leader x followers
- differential terms

Reinsurance of Insurance Risk

# Reinsurance Pricing

# Pricing Techniques

## EXPERIENCE

- enough loss data
- extrapolates historical experience
- does not reflect changes in portfolio and its structure
- works with either individual company or market based parameters

## EXPOSURE

- claims experience is limited
- significant changes in portfolio
- works with market based parameters (increased limits factors or property exposure curves)

Burning Cost

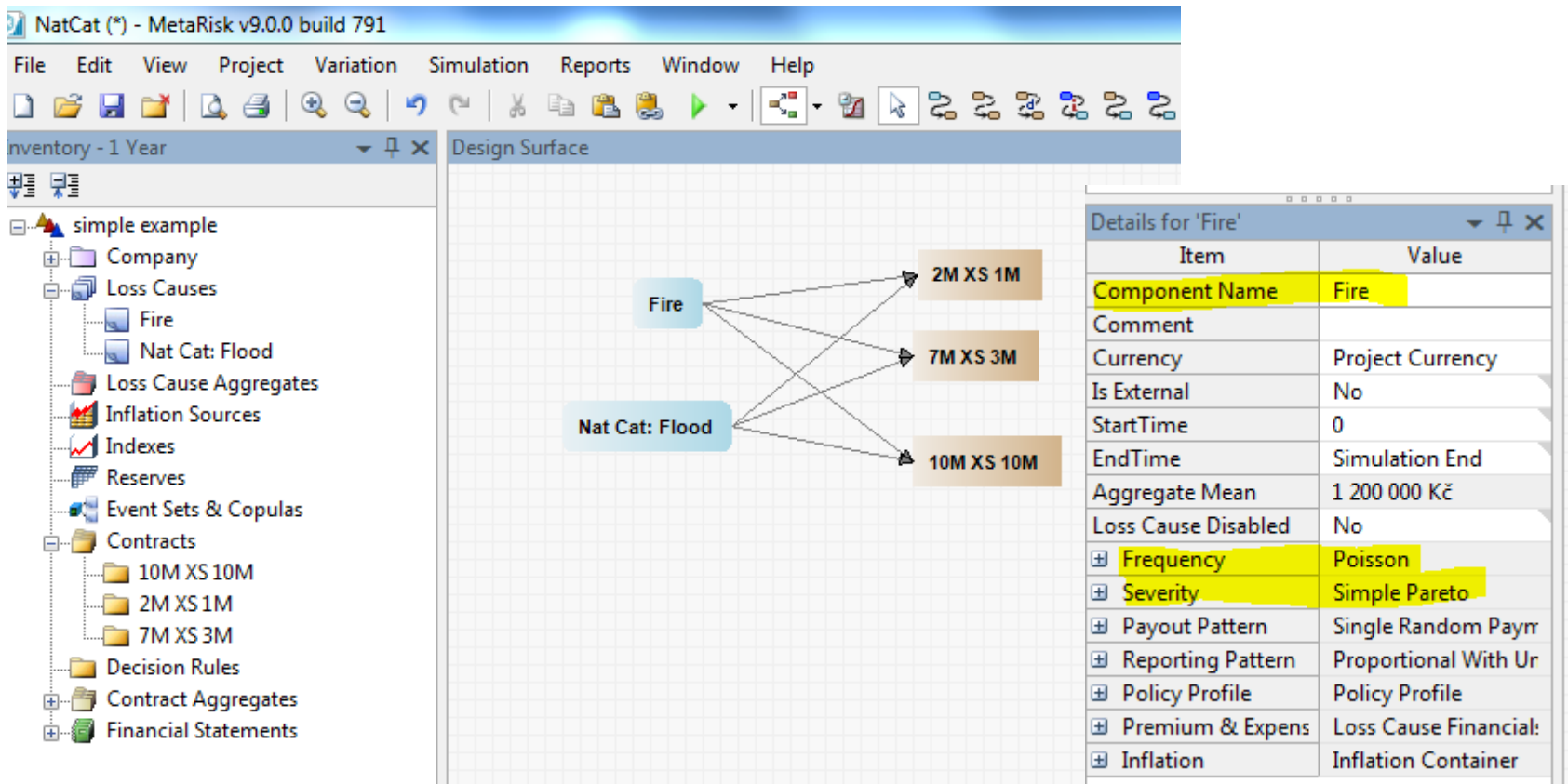
Probabilistic

## Exposure Rating

- For property business based on the MBBEFD distribution of degree of damage
- For liability business based on ILF (increased limits factors)
- More details on: <http://www.actuaria.cz/sdeleni.asp?ID=790>

## Reinsurance Pricing

# Example of Probabilistic Model: Structure



The screenshot shows the NatCat software interface with the following components:

- File Explorer:** A tree view on the left showing the project structure under 'simple example', including folders for 'Company', 'Loss Causes', 'Loss Cause Aggregates', 'Inflation Sources', 'Indexes', 'Reserves', 'Event Sets & Copulas', 'Contracts' (with sub-folders for '10M XS 10M', '2M XS 1M', and '7M XS 3M'), 'Decision Rules', 'Contract Aggregates', and 'Financial Statements'.
- Design Surface:** A central workspace showing a flowchart. Two blue boxes labeled 'Fire' and 'Nat Cat: Flood' have arrows pointing to three brown boxes representing contract types: '2M XS 1M', '7M XS 3M', and '10M XS 10M'.
- Details for 'Fire':** A table on the right showing the configuration for the 'Fire' component.

Item	Value
Component Name	Fire
Comment	
Currency	Project Currency
Is External	No
StartTime	0
EndTime	Simulation End
Aggregate Mean	1 200 000 Kč
Loss Cause Disabled	No
Frequency	Poisson
Severity	Simple Pareto
Payout Pattern	Single Random Paym
Reporting Pattern	Proportional With Ur
Policy Profile	Policy Profile
Premium & Expens	Loss Cause Financial!
Inflation	Inflation Container

## Reinsurance Pricing

# Example of Probabilistic Model: Ceded Loss

	10M XS 10M	2M XS 1M	7M XS 3M
Mean	64 247 Kč	300 084 Kč	183 145 Kč
Standard Deviation	723 297 Kč	679 754 Kč	955 913 Kč
CV	1 125,80%	226,52%	521,94%
Minimum	0 Kč	0 Kč	0 Kč
Maximum	20 000 000 Kč	7 594 764 Kč	15 503 263 Kč
Samples	100000	100000	100000
Non-Zero Probability	1,11%	29,09%	6,53%
<b>VaR Summary</b>			
1 in 10 VaR	0 Kč	1 320 017 Kč	0 Kč
1 in 20 VaR	0 Kč	2 000 000 Kč	594 739 Kč
1 in 50 VaR	0 Kč	2 216 432 Kč	3 751 243 Kč
1 in 100 VaR	774 860 Kč	2 831 461 Kč	7 000 000 Kč
1 in 200 VaR	6 554 118 Kč	3 605 422 Kč	7 000 000 Kč
1 in 250 VaR	9 140 703 Kč	3 857 922 Kč	7 000 000 Kč
<b>Shape</b>			
Accumulations	2	3	3
Moments			
Central Moments			

# Thank you for your attention !



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