

SOME PHANTASIES WITH INDICES

From a One Period to a Multiperiod Model

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-
- PillarOne Dynamic Reinsurance Analysis
 - Indices - Deterministic and Stochastic
 - Multiply indices – think modular
 - Modes: Interpolation vs. Stepwise
 - Interaction with patterns
 - Central European Example
 - Correlations

PODRA



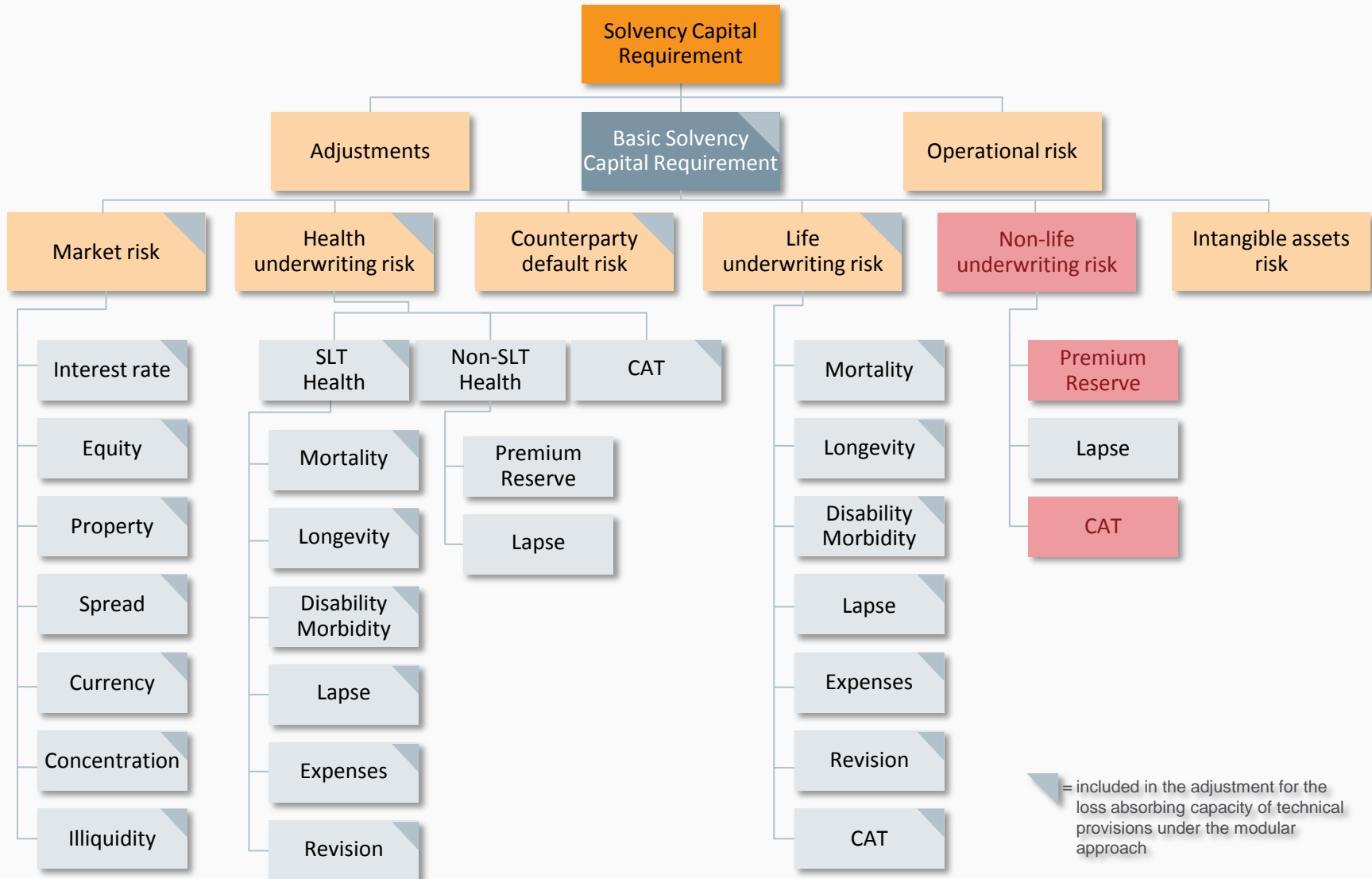
What is PODRA? PillarOne Dynamic Reinsurance Analysis

- PODRA is a **tool developed by Munich Re** to describe and measure underwriting risk in P&C insurance business.

- It is based on **PillarOne.RiskAnalytics**, an **open-source** software initiated and sponsored by Munich Re.



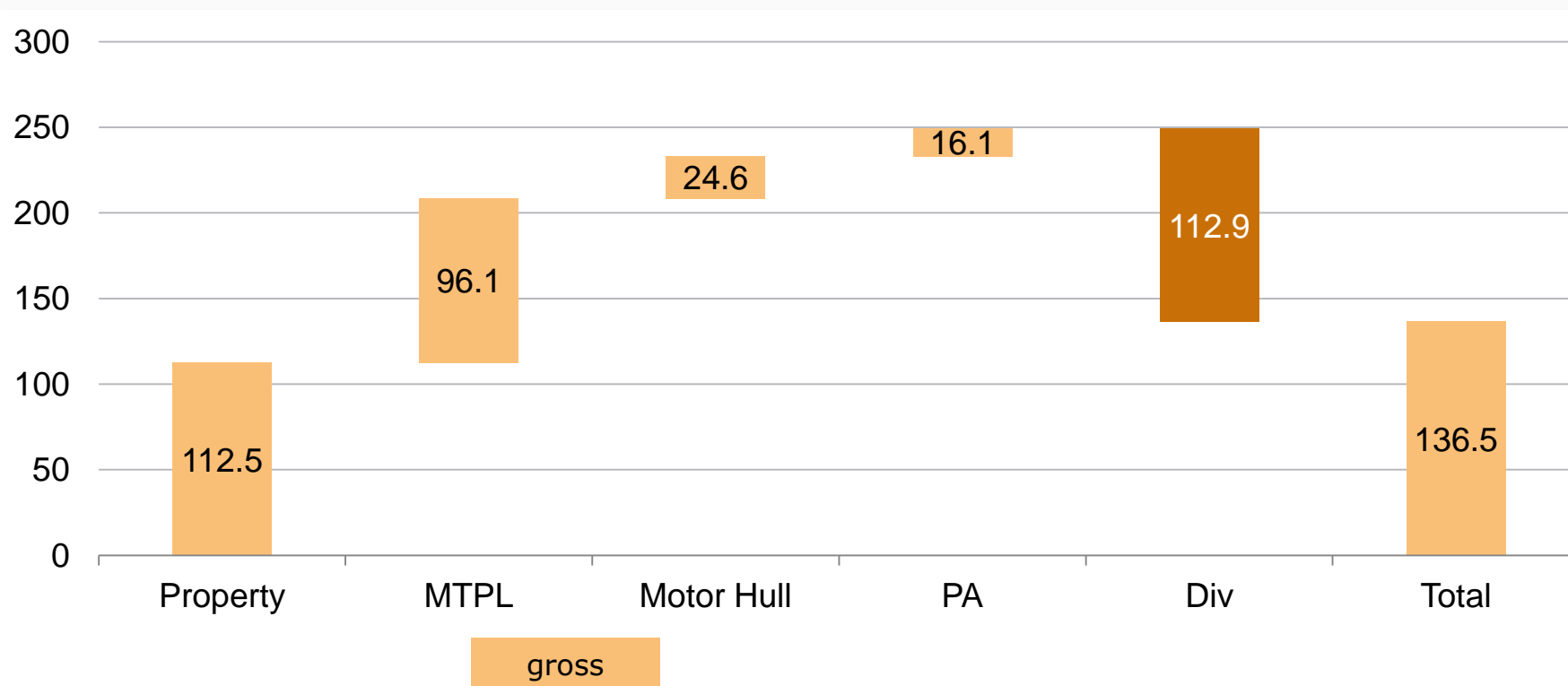
Which part of the Solvency Capital Requirement (SCR) is covered by PODRA?



Whole portfolio before reinsurance

SCR per line of business, gross

in m€

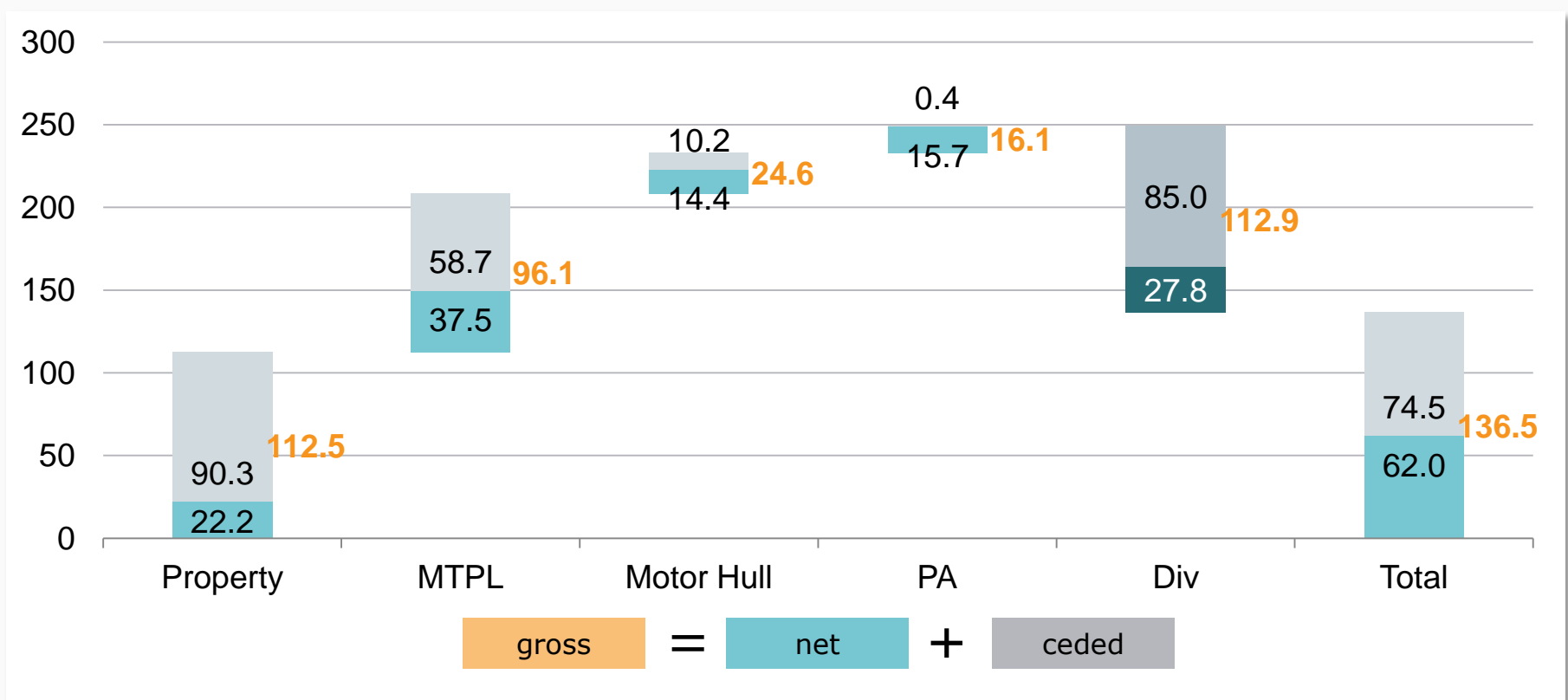


Before reinsurance portfolio was inhomogeneous

Reinsurance effect on whole portfolio



SCR per line of business, gross / net in m€

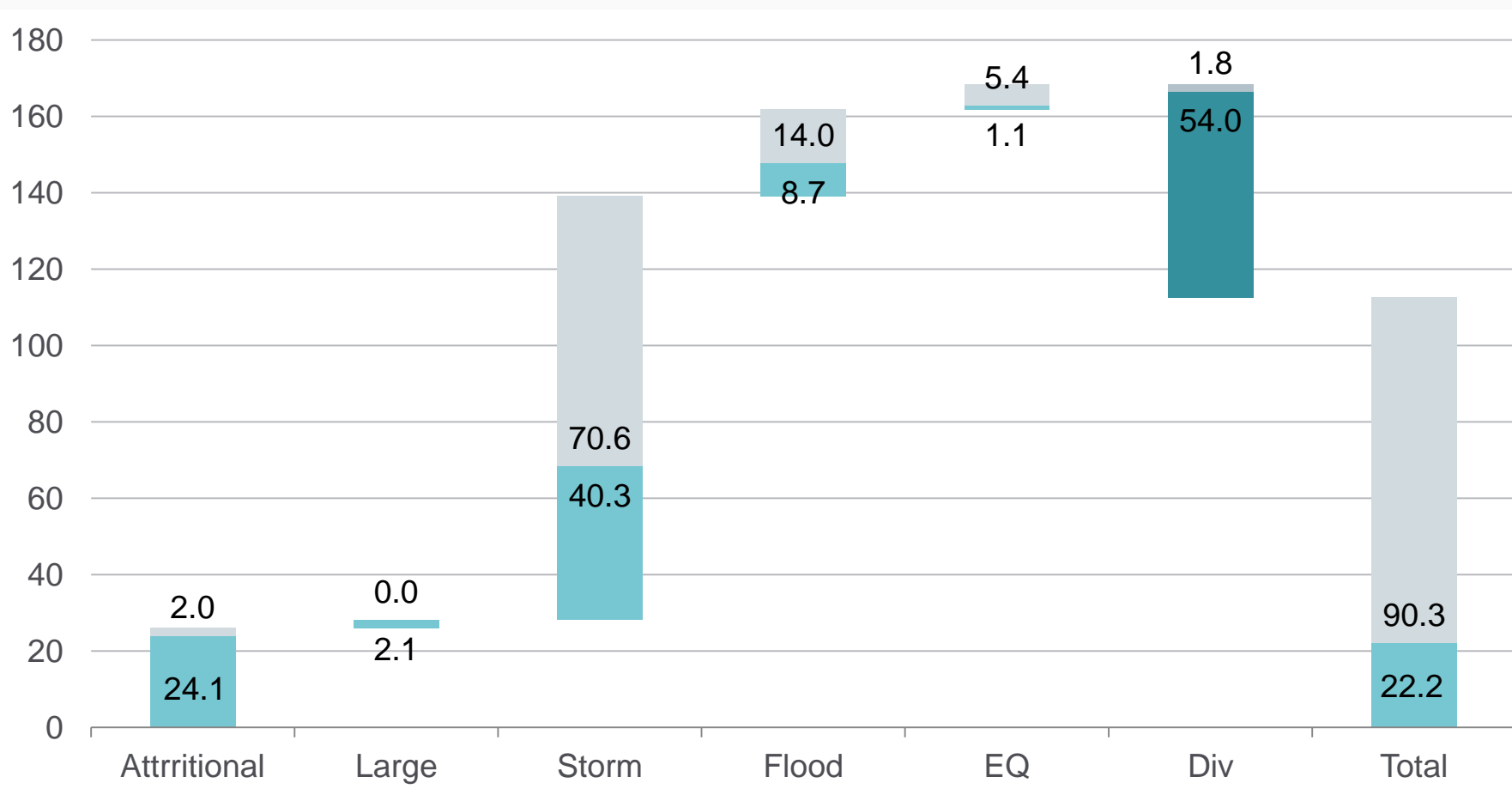


Net portfolio is more homogeneous – diversification reduced

Line of business: Property Reinsurance effect (NP)

SCR per loss type, Property, gross / net

in m€



Data and Calibration

Attritional and large losses

		Property	MTPL	Motor Hull	PA
	Gross premium	97	189.2	53.9	72.9
	loss threshold x_0	0.5	1	0.2	0.07
Attritional losses ($\leq x_0$)					
	loss ratio distribution	LogNormal	LogNorm	LogNorm	LogNorm
	μ	80.0%	82.3%	39.0%	56.3%
	σ	5.4%	7.0%	9.0%	11.4%
Large losses ($> x_0$)					
	frequency distribution	Poisson	Poisson	Poisson	Poisson
	λ	1	4.87	3,63	13.32
	severity distribution	Pareto	Pareto	Pareto	Pareto
	α	0.52	1.42	1,23	1,76
	Limit	20	100	3	1
Cat losses					
	Earthquake	PML-curve			
	Flood	PML-curve			
	Storm	PML-curve			

in m€



thumb

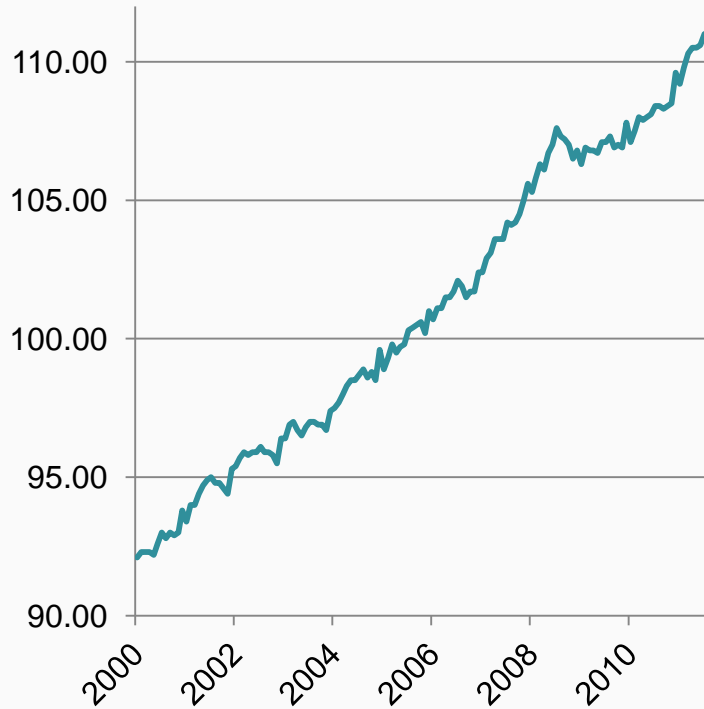
index finger

middle finger

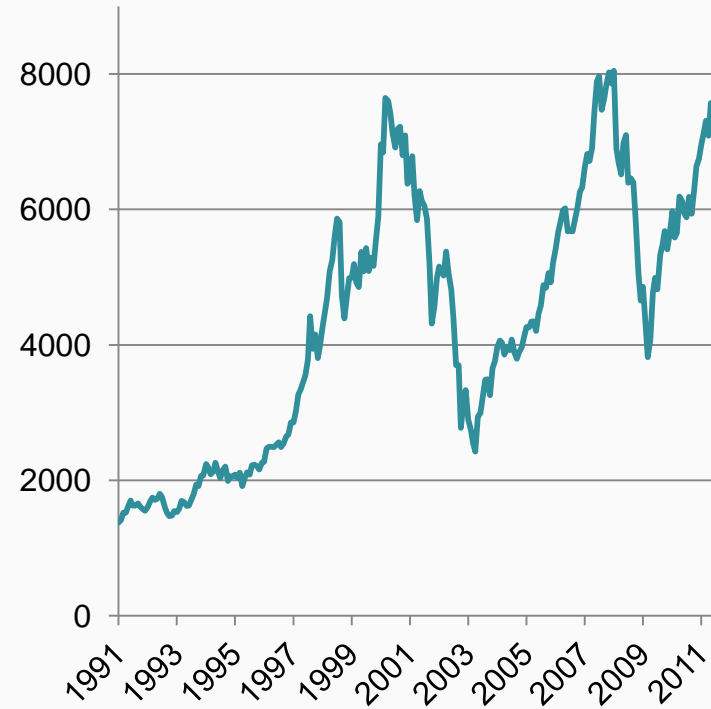
ring finger

pinkie

Consumer Price Index

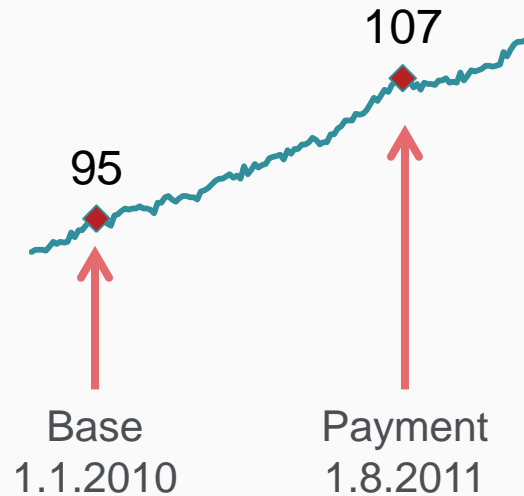


DAX



**Indices often describe the past –
in GIRA their focus is future development**

How to apply an index to a payment



Payment

before index: 100 €

Base date of index: 1.1.2010

Date of payment 1.8.2011

Read off index values

at base date: 95

at date of payment 107

Index Factor $107/95 = 1.13$

Payment indexed

$100€ \times (\text{Index Factor}) = 113 €$

Classic : Loss Size

Development of losses because of

- Inflation
- Wage increase
- Change in jurisdiction
- Increase of construction costs

Other Indices in GIRA

Indices used to calibrate loss generators and reserves

- Frequency index
- Policy index
- Premium index

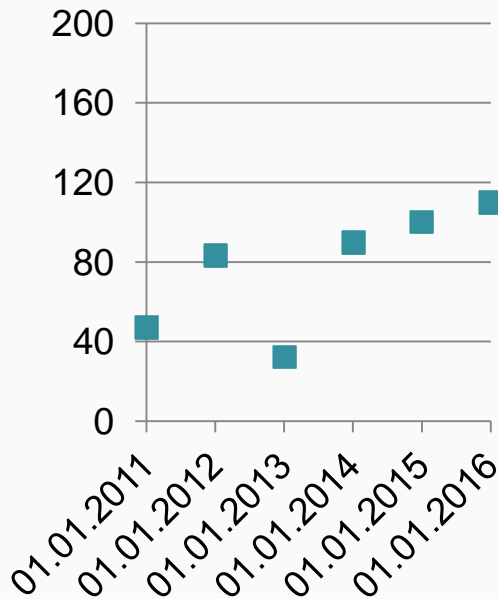
Many applications of indices

How to define an index



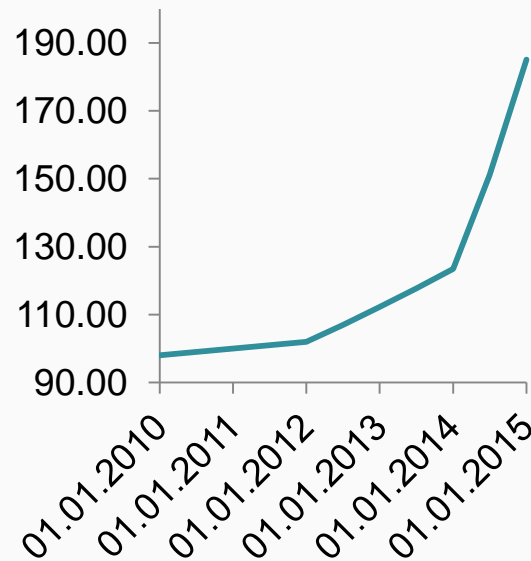
Deterministic Index Series

Date	Index Level
Jan 01, 2011	47
Jan 01, 2012	83
Jan 01, 2013	32
Jan 01, 2014	90
Jan 01, 2015	100
Jan 01, 2016	110



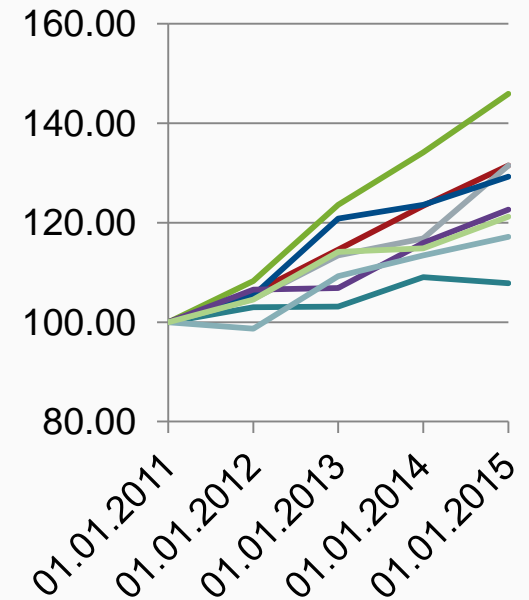
Deterministic Annual Changes

Date	Annual Change
Jan 01, 2010	0.02
Jan 01, 2012	0.1
Jan 01, 2014	0.5



Stochastic

Distribution	
Type	Normal
Mean	0.06
Standard Deviation	0.04



	Base values	2011	2012	2013
Base Inflation	100	110	115	150
Extra Inflation	90	90	100	180
Index Factors				
Base Inflation		1.10	1.15	1.50
Extra Inflation		1.00	1.11	2.00
Total factor		1.10	1.28	3.00

Examples

- Common market inflation (used both for attritional and large losses)
- Extra inflation for large losses
- Clause inflation
- Superimposed inflation

Modular approach for working with indices

DATES AND VOLATILITY



Applying a stochastic index to losses with date



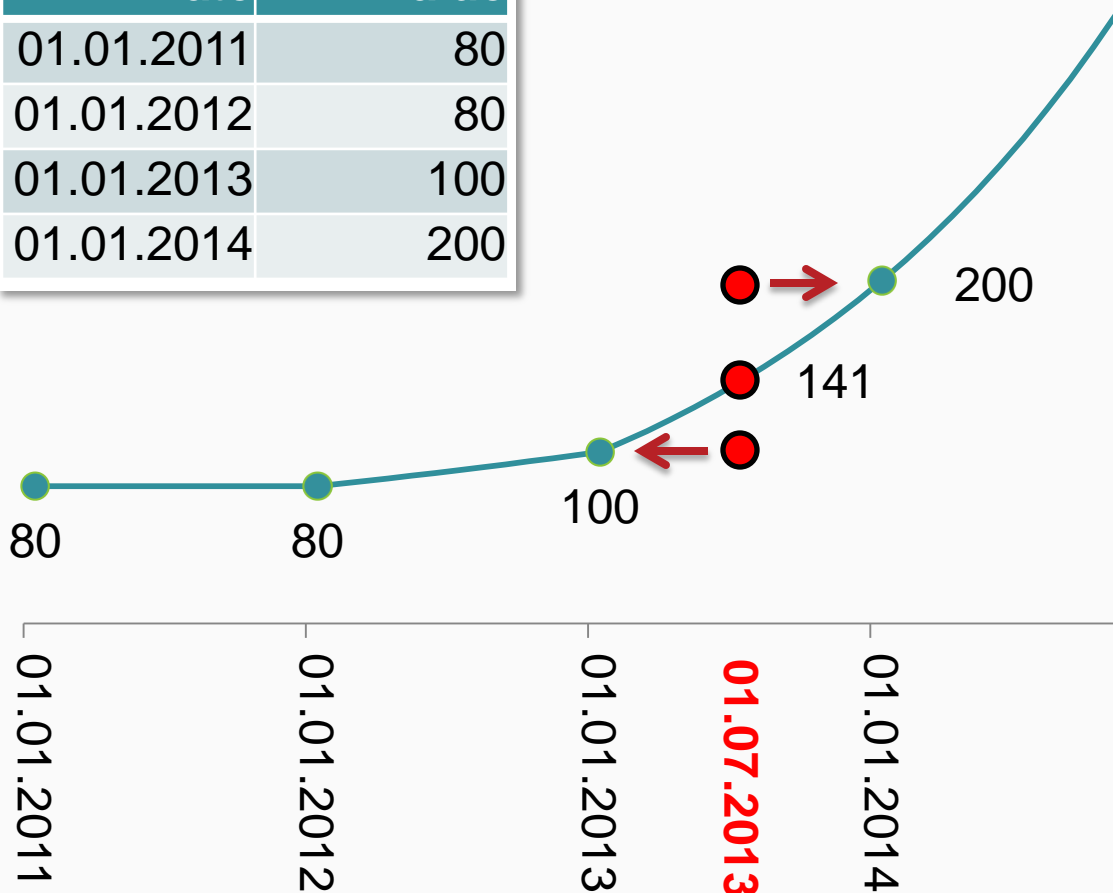
Reserve volatility depends on date of loss if stochastic index is applied continuously!

Three modes to read off an index

Input: Index
(given as index series)

Date	Value
01.01.2011	80
01.01.2012	80
01.01.2013	100
01.01.2014	200

Question
Value @ 01.07.2013 ?



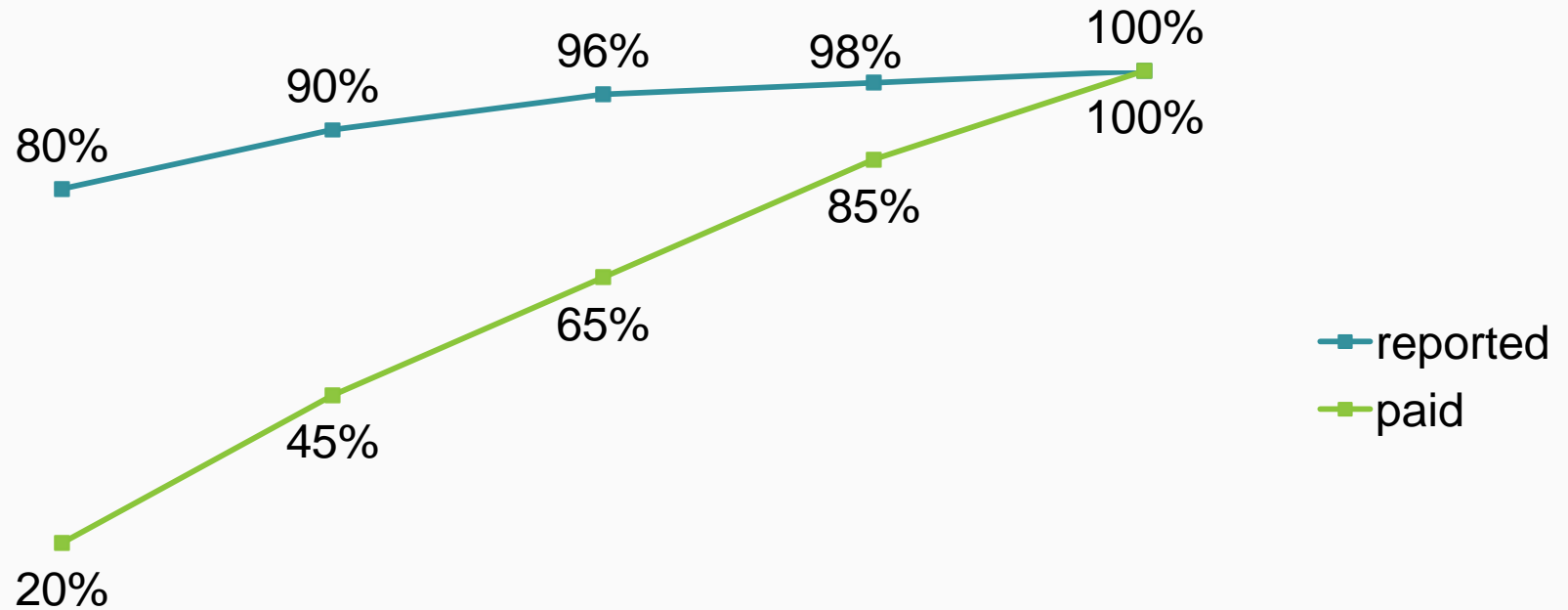
Answer
depends on index mode

Mode	Value
Stepwise next	200
Continuous	141
Stepwise previous	100

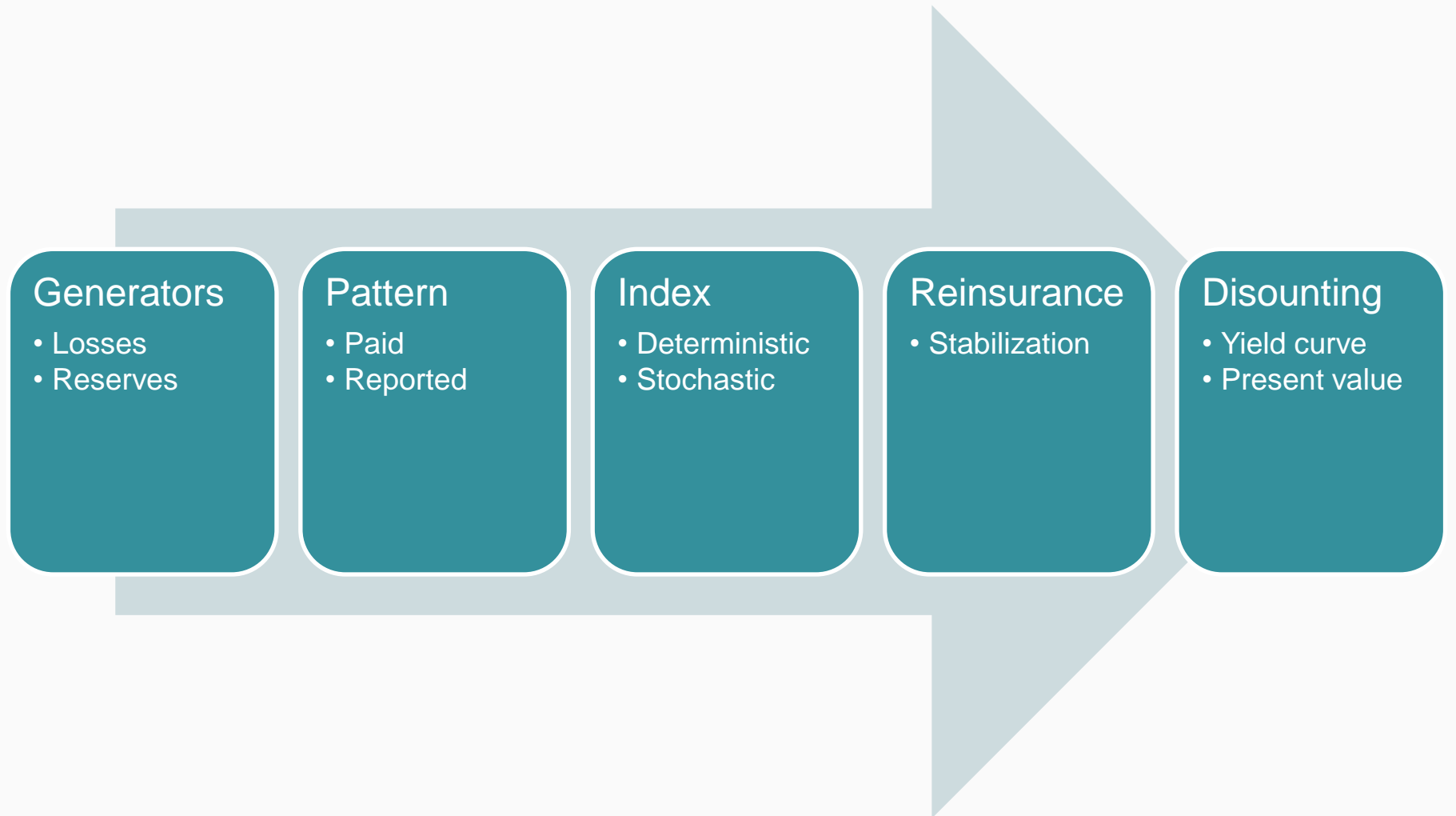
PATTERN, INDEX, YIELD CURVE

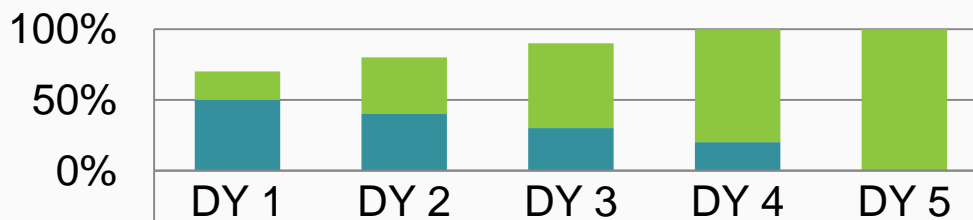


Interaction of patterns and indices – words



Patterns describe payout and reporting BEFORE application of index





**Absolute Loss
before Index**

1500€

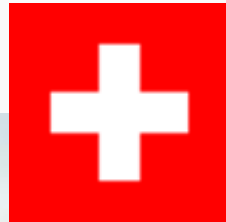
	DY 1	DY 2	DY 3	DY 4	DY 5
reported (cumul)	70%	80%	90%	100%	100%
paid (cumul)	20%	40%	60%	80%	100%
outstanding (cumul)	50%	40%	30%	20%	0%

Paid	DY 1	DY 2	DY 3	DY 4	DY 5
cumul. €	300	600	900	1,200	1,500
incr. €	300	300	300	300	300
index factor	1.00	1.10	1.21	1.33	1.46
incr. indexed €	300	330	363	399	439

Outstanding	DY 1	DY 2	DY 3	DY 4	DY 5
cumul. €	750	600	450	300	0
index factor	1.00	1.08	1.17	1.26	1.36
cumul. indexed €	750	648	525	378	0

Individual indices can be applied for paid and outstanding claims.

EXAMPLE



Example

Foreign currency segment

sFr/Eur



- Model fx-rate as stochastic index
- Apply index cash flows of premiums and claims/reserves

CORRELATIONS AND INDICES



Soldiers marching lock-step are 100% correlated



Angers Bridge collapsed on April 16, 1850, when 478 French soldiers marched across it lock-step.



§ 27 StVO, Abs. 6

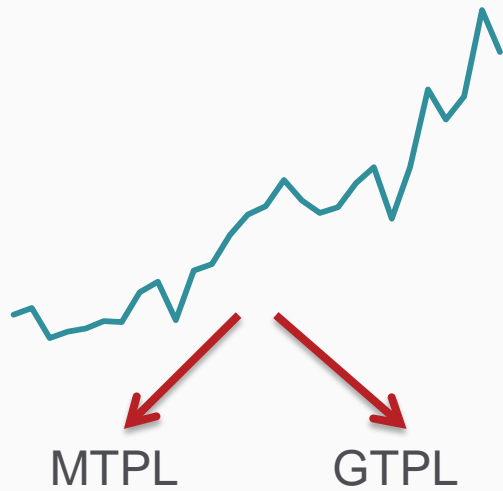
Auf Brücken darf nicht im Gleichschritt marschiert werden.

High Correlations increase total risk tremendously

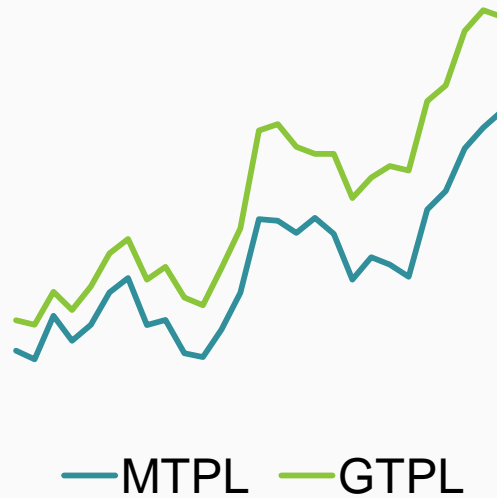


	Market risk	Counterparty default risk	Life Underwriting risks	Health underwriting risk	Non-Life underwriting risk
Market risk	100%	25%	25%	25%	25%
Counterparty default risk	25%	100%	25%	25%	50%
Life Underwriting risks	25%	25%	100%	25%	0%
Health underwriting risk	25%	25%	25%	100%	0%
Non-Life underwriting risk	25%	50%	0%	0%	100%

We want to model correlations



Apply index twice



Correlate indices



Correlate loss generators and index

THANK YOU VERY MUCH
FOR YOUR ATTENTION

Dr. Arnold Waßmer