PODRA - PillarOne
Dynamic Reinsurance Analysis

Jörg Dittrich, Munich Re

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  - Goals
  - Project
  - Open-source
  - Sponsorship
- PODRA – PillarOne Dynamic Reinsurance Analysis
  - Modeling
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  - Calibration
  - Risk mitigation instruments
  - Evaluation

What is behind PillarOne?
A platform for risk management

PillarOne is

- a **risk-analysis platform** providing decision-making support for risk management,
- compatible with **process and audit requirements** of an insurance company,

and supports

Processes	Tasks	
Segmentation/modelling	Customising models	Documentation
Calibration	Integrating company data	
Analysis	Determining risk metrics	
Presentation	Processing results	

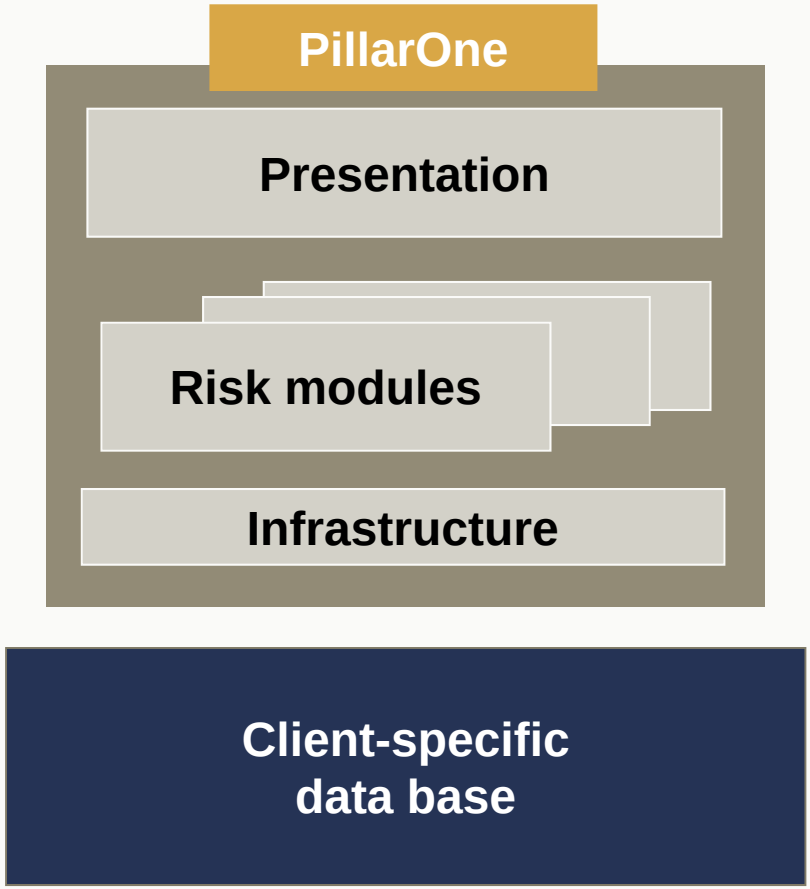
Integrating risk management into corporate processes

Risk-oriented methods are at the core of insurance business

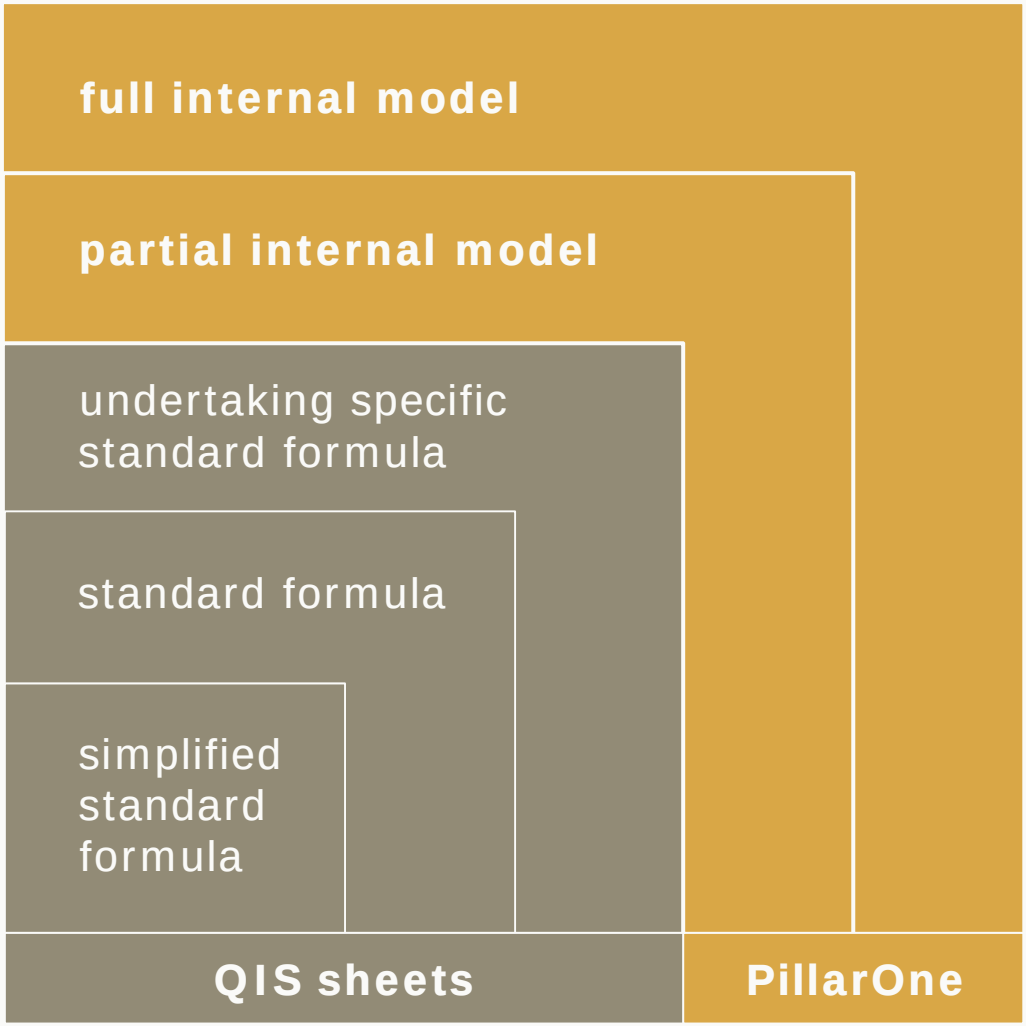
- Customised processes can provide competitive advantages.
- The processes reference standardised and customised actuarial methods.

PillarOne will

- encompass standardised methods as well as incorporating customised methods,
- and support the required documentation processes.



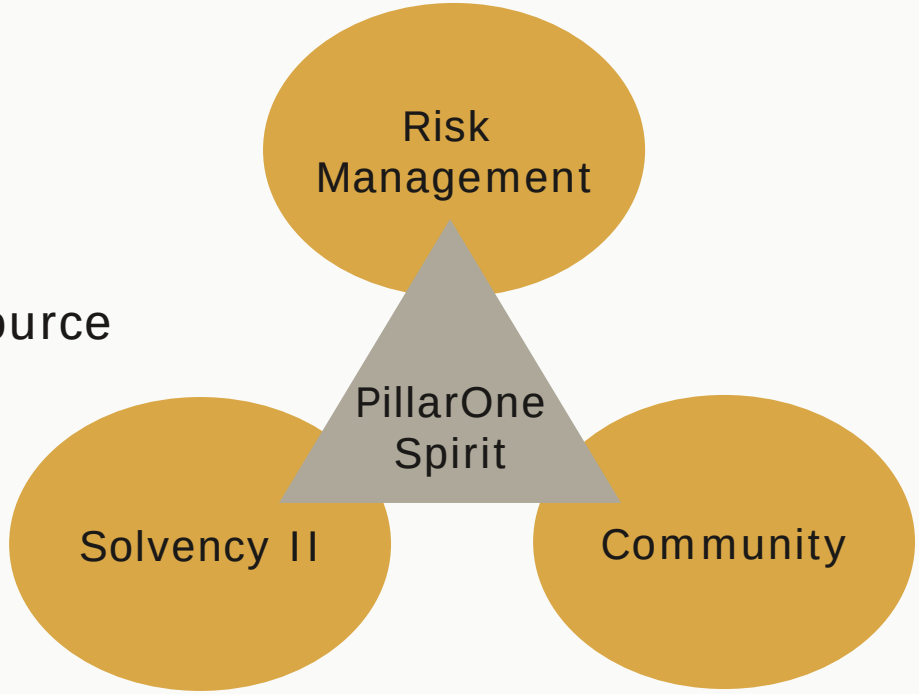
Different options to estimate the SCR – PillarOne provides solutions for Solvency II



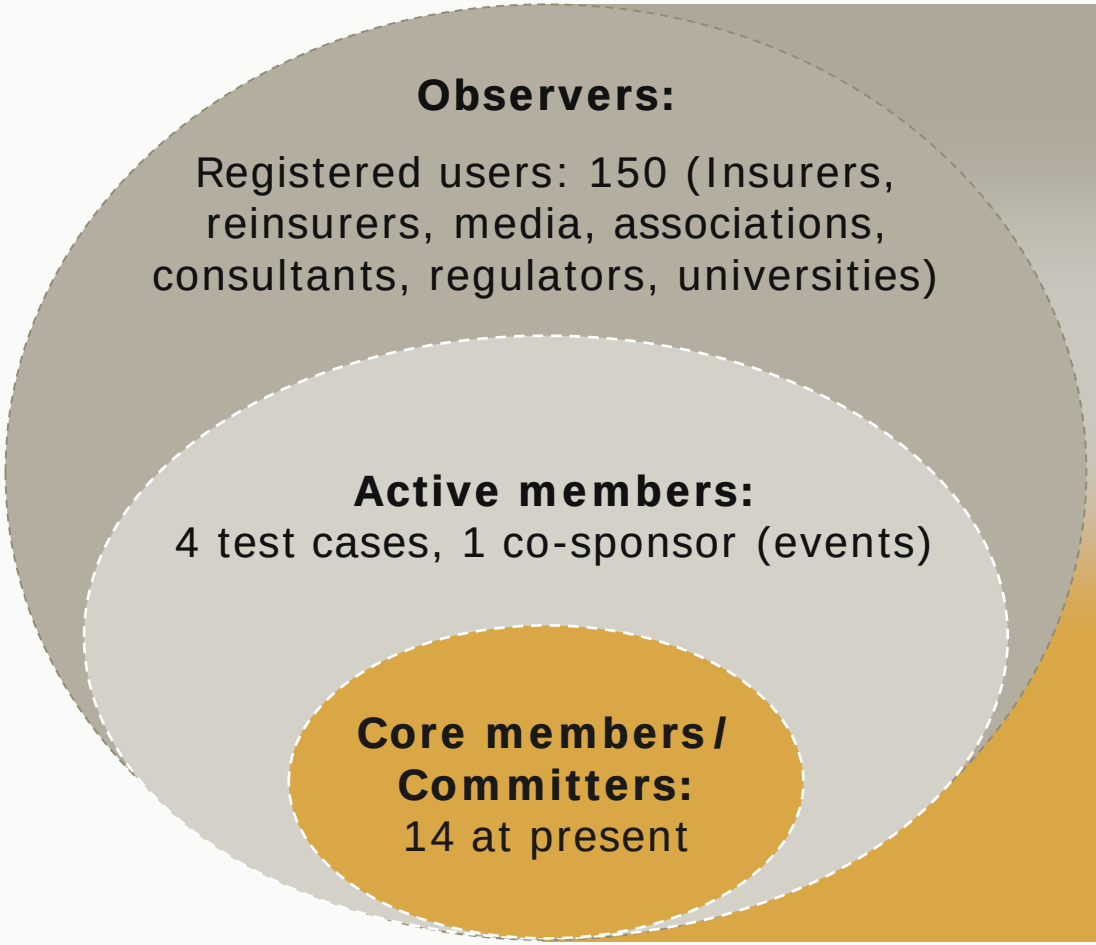
What drives PillarOne?

PillarOne is driven by

- a **community** for exchanging concepts and methods and for discussing issues concerning enterprise risk management
- economic and regulatory **requirements** to build risk management applications
- a **spirit of sharing** – open source



The PillarOne community: realise your ideas!



- Intuitive Collaboration
- Canoo Engineering
- Munich Re

Why open-source?

- **Transparency** is an asset in risk management: actuaries, consultants, risk managers, and regulators should know how things are done.
- An open, collaborative process is the best way to **empower users** to shape products.
- Open-source methodology and technology allows the broadest form of **collaboration**; there are no barriers to contributing ideas.
- It represents a new attitude towards **intellectual property**: accessing it is free, but delivering it costs (commercial open-source).
- It encourages a service-providing **ecosystem**.
- PillarOne means: **independence** from a single provider.

Why is Munich Re sponsoring PillarOne?

"As the initiator and main sponsor of PillarOne, Munich Re supports specialised and medium-sized insurance companies to optimise their risk management, as it is very costly for such companies to build up their own internal models."

"Munich Re feels that the standard model does not adequately take reinsurance into account in the Solvency II context. We see the greatest potential for improving standards of specialised and medium-sized insurance companies in the logic of the open-source platform. With PillarOne, Munich Re can directly address such companies and offer them customised consultation as well as reinsurance capacity."

The focus on (partial) internal models in the insurance industry

Dynamic Reinsurance Analysis using PillarOne gives options to answer risk specific questions

- What is my overall annual risk situation?
- What are my main risk drivers?
- What is the overall capital requirement of the assumed insurance policies?
- How can we allocate the overall capital requirements to individual policies?
- What is the capital relief of our reinsurance policy?
- What is our SCR under Solvency II regulation?

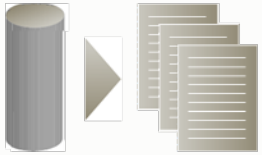
A model is needed to answer this questions: **PODRA**

The five steps of Dynamic Reinsurance Analysis

The PODRA Service - Process Illustration

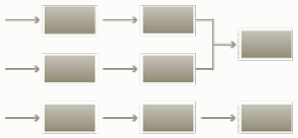
Modeling

Data requirements

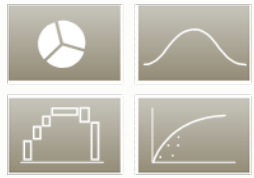


Calibration

Risk mitigation instruments



Evaluation

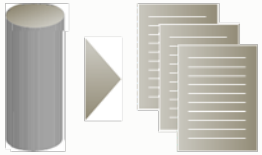


The five steps of Dynamic Reinsurance Analysis Modeling

The PODRA Service - Process Illustration

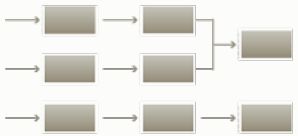
Modeling

Data requirements

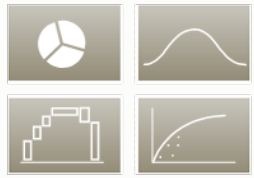


Calibration

Risk mitigation instruments



Evaluation



Modeling: based on a elaborate discussion of the business

- Specify of result variables and key risk indicators
- Segmentation of the Business (Lines of Business, Perils, ...)
- Assign model components to the segments
- Consider diverse loss components for attritional, large and catastrophic losses according to different perils
- Allowance for special features of the business
- Consider dependency structures
- Define embeddable reinsurance structures

Modeling: Definition of Result Variables
What can the model be used for?

- What risk information do we require for steering purposes?
- What risk information do we use to fulfill the requirements of the regulatory regime / the regulator?
- Should the modeling reflect future developments like Solvency II?

Options for Result Variables:

- Annual aggregated loss (gross and net retained)
- Results (net premium – net losses + commissions)

Options for (Risk) Measures on Result Variables:

- Expected Value
- Value at Risk at the 99.5% confidence level

Agreement on possible results should be reached

Capital Eagle: The P&C insurer
Are we prepared for modeling

- Founded in 1998 by
  - N. Kuschel, CEO, COO and Reinsurance Manager
  - A. Majidi, CRO and Chief Actuary
- Consultants
  - J. Dittrich, Project Manager, Munich Re
  - L. Berthaut, Consultant, Munich Re

- On Capital Eagle refer to Munich Re Knowledge Series:

http://www.munichre.com/publications/302-05823_en.pdf

Capital Eagle
Definition of Result Variables

pillar 1
Risk Management meets Open Source

Result Variables:

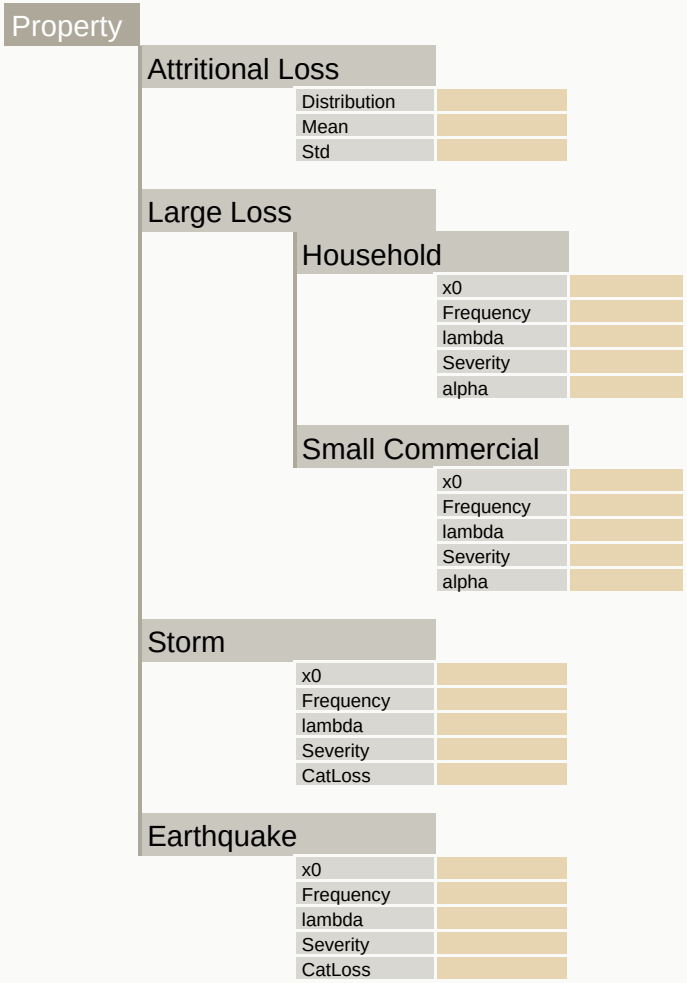
- Annual aggregated loss (gross and net retained)
- Results (net premium – net losses + commissions)

Measures on Result Variables:

- Expected Value
- Value at Risk at the 99.5% confidence level
- Standard Deviation

Agreement on results reached

Capital Eagle
Modeling of Property Business



- Segment: Property
- Attritional Loss: Aggregate Distribution
- Large Loss separeted for Household and Small Commercial losses
- Frequency / Severity approach
- Natural Perils: Storm and Earthquake
- Frequency / Severity derived from exposure based analysis

Capital Eagle
The Model in PillarOne

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Risk Management meets Open Source

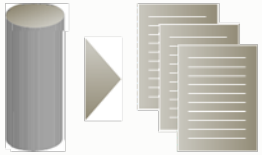
```
package models.capitalEagle

import org.pillarone.modelling.domain.lob.ExampleLob
import org.pillarone.modelling.simulation.Model
import org.pillarone.modelling.domain.lob.PropertyLob
import org.pillarone.modelling.domain.aggregators.ClaimsAggregator

class CapitalEagleModel extends Model {
    ExampleLob mtpl
    ExampleLob motorHull
    ExampleLob personalAccident
    PropertyLob property
    ClaimsAggregator claimsAggregator

    ...

    public void wireComponents() {
        claimsAggregator.inClaimsGross = mtpl.subRiProgram.outClaimsGross
        claimsAggregator.inClaimsGross = motorHull.subRiProgram.outClaimsGross
        claimsAggregator.inClaimsGross = personalAccident.subRiProgram.outClaimsGross
        claimsAggregator.inClaimsGross = property.subRiProgram.outClaimsGross
        claimsAggregator.inClaimsCeded = mtpl.subRiProgram.outClaimsCeded
        claimsAggregator.inClaimsCeded = motorHull.subRiProgram.outClaimsCeded
        claimsAggregator.inClaimsCeded = personalAccident.subRiProgram.outClaimsCeded
        claimsAggregator.inClaimsCeded = property.subRiProgram.outClaimsCeded
    }
}
```

The five steps of Dynamic Reinsurance Analysis
Data requirements

The PODRA Service - Process Illustration

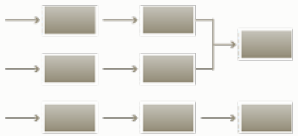
Modeling

Data requirements

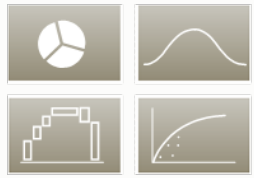


Calibration

Risk mitigation instruments

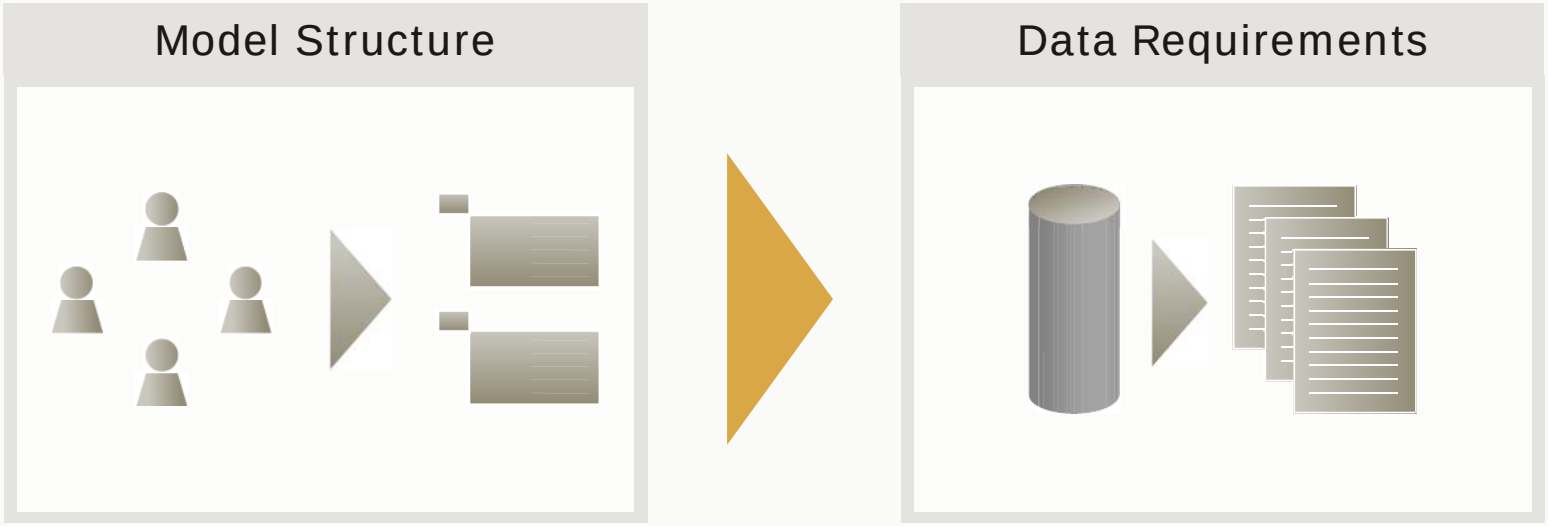


Evaluation



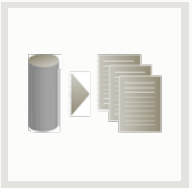
Data requirements
What is necessary to get the model running?

- Model structure defined and proposed
- What parameter set can be derived from the model structure?
- Are parameter fitting and calibration methods identified?
- What data requirements do the fitting and calibration methods have?



Data requirements
Detailed specification

The following data are required for a PODRA:



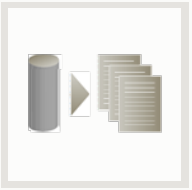
- completed QIS4 Sheet*
- Definition of segments to be analysed (lines of business, LoBs)
- Segment specific information (see next slide)
- Reinsurance structure in place
- Risks usually ceded facultatively

- Known alternative reinsurance structures

* optional: for calculation of Solvency II key figures

Data requirements: Detailed specification
Segment specific information

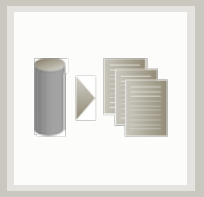
Data requirements for a segment to be modelled in PODRA



- Segment information in line with QIS4 Sheet *
- Premium statistics (calendar year or underwriting year with run-off)
- Aggregate loss amounts per LoB (run-off triangles/ calendar year losses)
- Individual loss amounts per LoB and occurrence year (incl. run-off/calendar year)
- Accumulation loss amounts per LoB and accident year (incl. run-off/calendar year) allocated on hazard
- Accumulation exposures as per e.g. CRESTA/Results of an accumulation risk analysis

* optional: for calculation of Solvency II key figures

Capital Eagle: Drawbacks from data requirements on the model



pillar 1
Risk Management meets Open Source

Large Loss

Household

x0	
Frequency	Poisson
lambda	
Severity	Pareto
alpha	

Small Commercial

x0	
Frequency	Poisson
lambda	
Severity	Pareto
alpha	

Data required

- Loss lists with qualifier
  - Household
  - Small Commercial

Data available

- Loss lists without qualifier

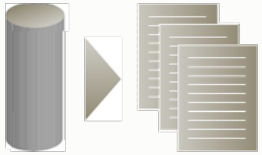
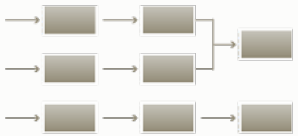
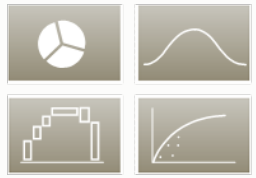
Large Loss

x0	
Frequency	Poisson
lambda	
Severity	Pareto
alpha	

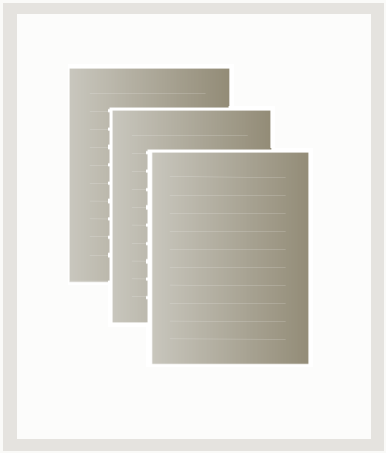
Model simplified due to restriction in available data

The five steps of Dynamic Reinsurance Analysis Calibration

The PODRA Service - Process Illustration

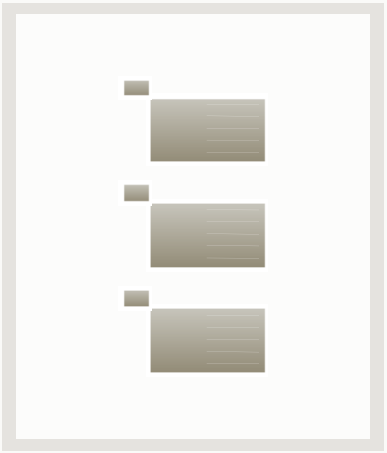
Modeling	Data requirements	**Calibration**	Risk mitigation instruments	Evaluation
				

Calibration: Which is the best parametrization for our model?



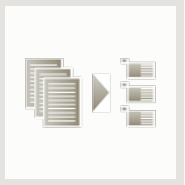
Calibration

- Distribution
  - Type assumption
- Parameter estimation
  - Mean
  - Standard deviation
  - Skewness
- Confidence ranges
  - Mean in Intervall [a,b] at 95% probability cannot be rejected



Calibration
Detailed specification

Data are linked with models



- Parameter estimates of models based on statistics
- Simulations with external nat cat tools
- Parameter estimates of models from nat cat simulations
- Adjustment of dependencies (optional)
- Simulation and plausibility test

Capital Eagle: Estimation of parameters by moment matching

Premium	Loss Ratio
35.515	50,15%
39.482	56,49%
42.822	58,89%
42.402	60,15%
32.315	51,30%
31.509	52,54%
26.200	45,47%
29.358	51,20%
30.322	53,61%
30.401	54,24%
29.967	53,93%
26.380	48,57%
24.064	46,04%

Calibration

$$\hat{\mu} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

$$\hat{\sigma} = \frac{1}{n-1}\sum_{i=1}^{n} \left(x_i - \hat{\mu}\right)^2$$

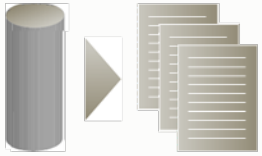
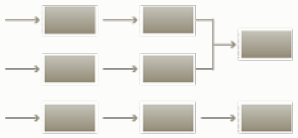
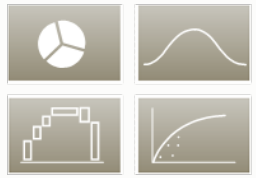
Property

Attritional Loss

Distribution	LogNorm
Mean	0,5251
Std	0,0444

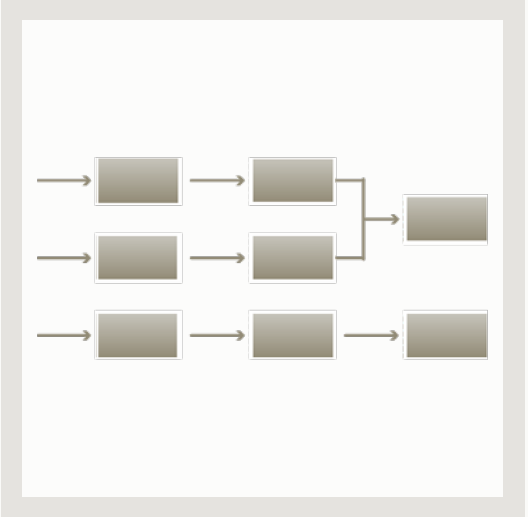
The five steps of Dynamic Reinsurance Analysis
Risk mitigation instruments

The PODRA Service - Process Illustration

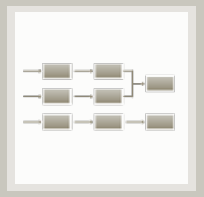
Modeling	Data requirements	Calibration	**Risk mitigation instruments**	Evaluation
				

Risk Mitigation
Representation of reinsurance

- Representation of current reinsurance program structure (LoBs, treaty reins. structures)
- Parametrisation of treaties
- Consideration of reinsurance premiums and determination of a premium calculation principle
- Optional: Definition of alternative reinsurance structures and parameters
- Calculation of reinsurance premiums equivalent to those used for current reinsurance structure



Capital Eagle
Reinsurance program alternatives



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Risk Management meets Open Source

PeakRisk (Peak risk cover)

Motor liability	ML WXL 95 xs 5	
Motor own damage	MOD CXL 10 xs 10	
Personal accident	PA WXL 1 xs 2	→ PA CXL 10 xs 2
Property	Prop. CXL 170 xs 10	

NP (Pure non-proportional cover)

	ML WXL 99 xs 1	
	MOD CXL 19,5 xs 0,5	
	PA WXL 2.8 xs 0.2	→ PA CXL 1.4 xs 0.2
	Prop. CXL 14 xs 1	→ Prop. SL 300% xs 100%

ML50+NP (ML quota share and NP cover)

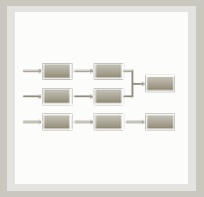
Motor liability	ML 50% quota share cession	→ ML WXL 99 xs 1	
Motor own damage		MOD CXL 19.5 xs 0.5	
Personal accident		PA WXL 2.8 xs 0.2	→ PA CXL 1.4 xs 0.2
Property		Prop. CXL 14 xs 1	→ Prop. SL 300% xs 100%

ALL 50+NP (Quota share and NP cover)

	ML 50% quota share	→ ML – WXL 99 xs 1	
	MOD 50% quota share	→ MOD CXL 19.5 xs 0.5	
	PA 50% quota share	→ PA WXL 2.8 xs 0.2	→ PA CXL 1.4 xs 0.2
	Prop. CXL 14 xs 1	→ Prop. 50% quota share	→ Prop. SL 300% xs 100%

The solvency capital is calculated based on four different reinsurance programmes.

Capital Eagle
Property Reinsurance in PillarOne

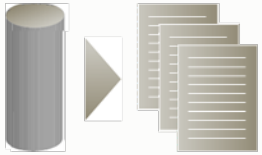
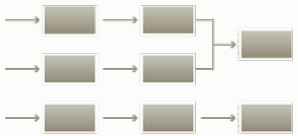
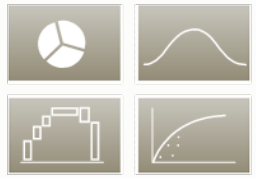


pillar 1
Risk Management meets Open Source

```
…
subRiProgram {
     subContract1 {
          parmContractStrategy[0]=…getContractStrategy(…ReinsuranceContractType.WXL,
               ["premiumBase":…PremiumBase.ABSOLUTE,"premium":800000.0,"reinstatementPremiums":new
               …TableMultiDimensionalParameter([0.5],["Reinstatement
               Premium"]),"attachmentPoint":1000000.0,"limit":4.2E7,"aggregateLimit":5.0E7,"covere
               dByReinsurer":1.0,])
          parmInuringPriority[0]=0
          }
     subContract2 {
          parmContractStrategy[0]=…ReinsuranceContractStrategyFactory.getContractStrategy(…Reinsur
               anceContractType.QUOTASHARE,
               ["quotaShare":0.5,"commission":0.0,"coveredByReinsurer":0.0,])
          parmInuringPriority[0]=1
          }
     subContract3 {
          parmContractStrategy[0]=…ReinsuranceContractStrategyFactory.getContractStrategy(…Reinsur
               anceContractType.STOPLOSS,
               ["premiumBase":…PremiumBase.ABSOLUTE,"premium":100000.0,"attachmentPoint":3.3960398
               E7,"limit":1.01881194E8,"coveredByReinsurer":1.0,])
          parmInuringPriority[0]=2
          }
…
```

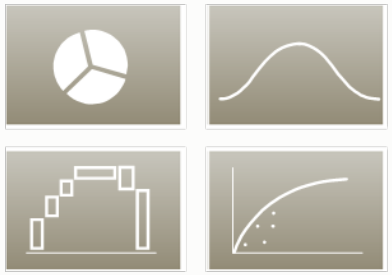
The five steps of Dynamic Reinsurance Analysis Evaluation

The PODRA Service - Process Illustration

Modeling	Data requirements	Calibration	Risk mitigation instruments	**Evaluation**
				

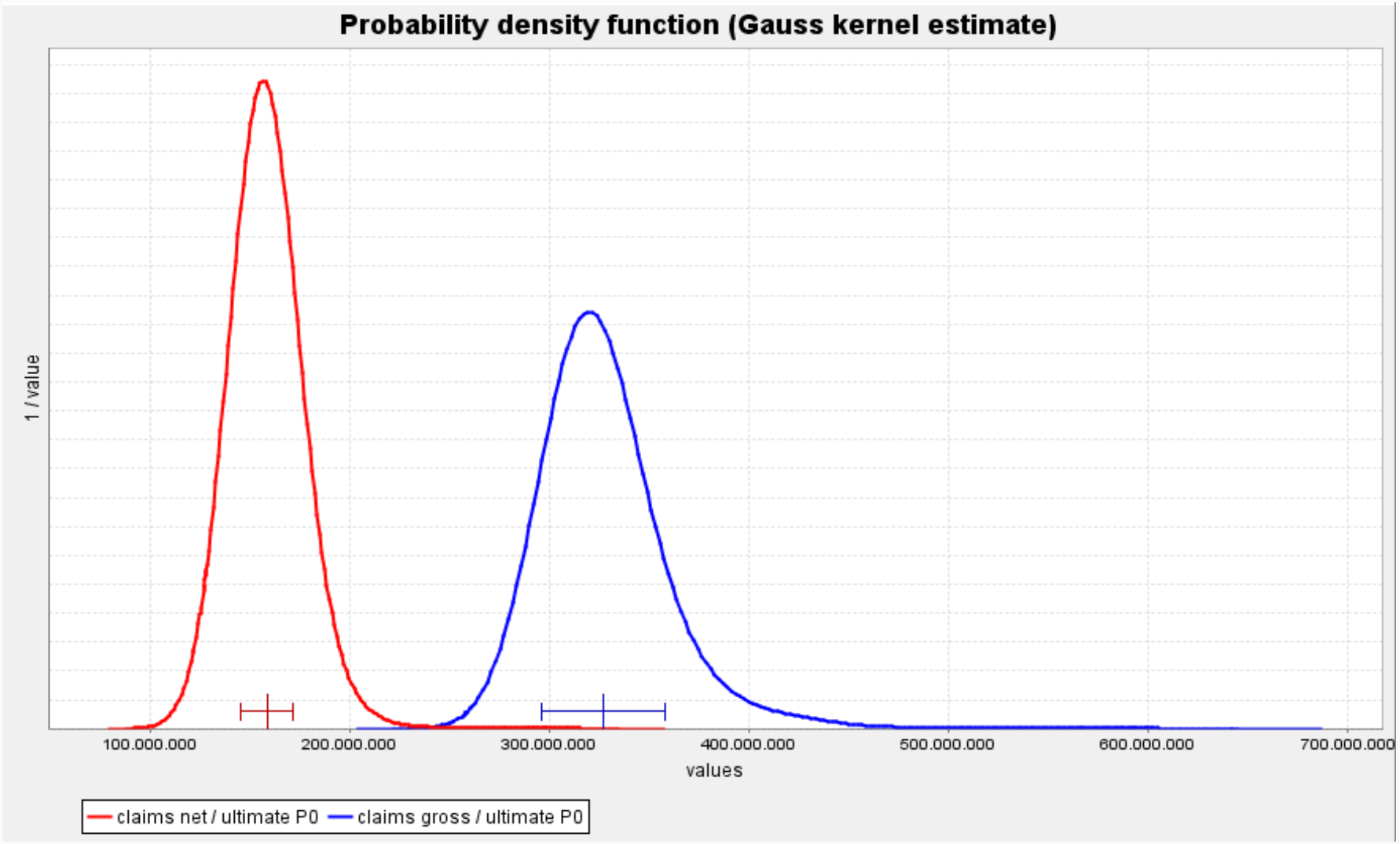
Result presentation
Detailed specification

- Preparation of information on the risk situation of the gross portfolio
- Description of risk situation under current reinsurance cession
- Details on the risk situation under alternative reinsurance structures
- Cost-benefit analysis of reinsurance structures
- Optional: Representation of results in line with Solvency II (QIS4)



* optional: only when QIS4 sheet completed

Capital Eagle
Loss distributions: gross vs. net

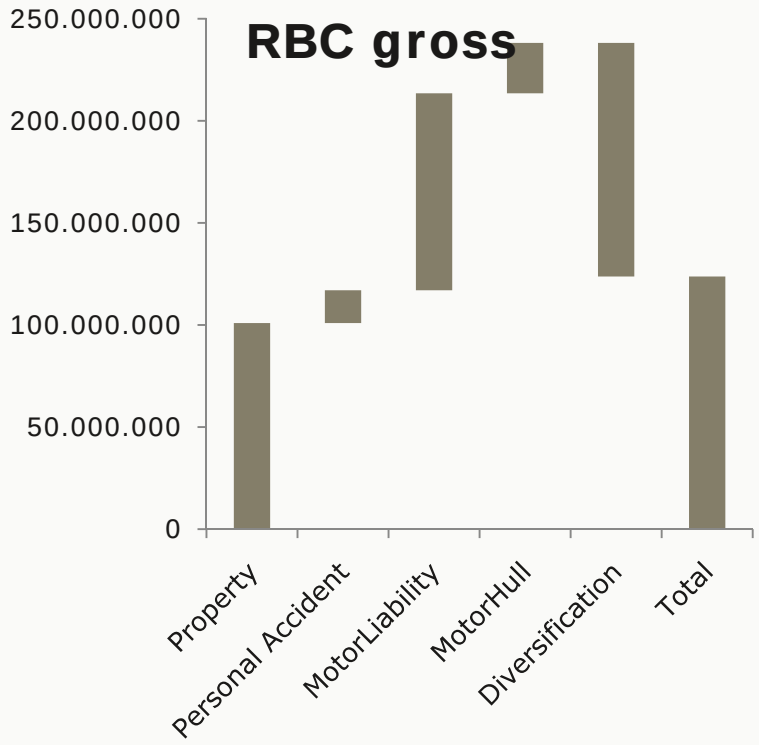


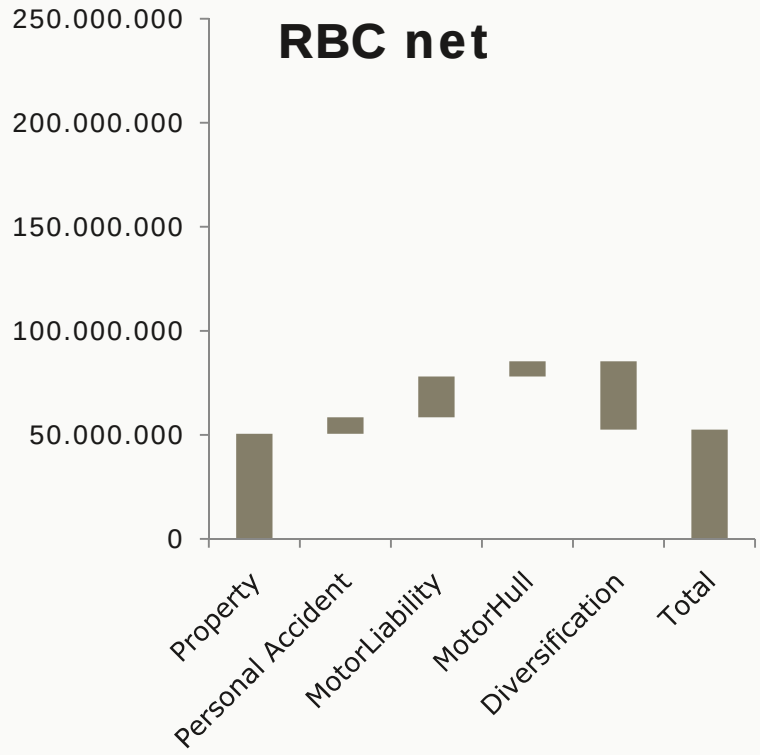
Capital Eagle
Risk measures

CapitalEagle	gross					
	premium	loss				
		expectation	st-deviation	RBC (VaR99,5)	RBC/expected	RBC/P Quote
Total	386.627.763	327.225.859	30.895.803	123.709.652	37,8%	32,0%
Diversification	0	0	-23.058.852	-114.493.888	-35,0%	
Property	72.939.000	52.584.426	21.538.236	100.979.108	192,0%	138,4%
Personal Accident	27.432.763	22.934.395	5.006.388	16.059.549	70,0%	58,5%
MotorLiability	189.242.000	170.917.303	20.323.717	96.438.041	56,4%	51,0%
MotorHull	97.014.000	80.789.735	7.086.314	24.726.843	30,6%	25,5%

CapitalEagle	net					
	premium	loss				
	-commission	expectation	st-deviation	RBC (VaR99,5)	RBC/expected	RBC/P Quote
Total	242.368.717	158.557.732	13.280.990	52.506.388	33,1%	21,7%
Diversification	0	0	-9.446.802	-32.875.530	-20,7%	
Property	44.524.335	26.292.213	10.769.118	50.489.554	192,0%	113,4%
Personal Accident	37.254.437	11.123.636	2.433.673	7.963.240	71,6%	21,4%
MotorLiability	105.000.924	81.830.311	6.875.267	19.634.347	24,0%	18,7%
MotorHull	55.589.022	39.311.572	2.649.734	7.294.777	18,6%	13,1%

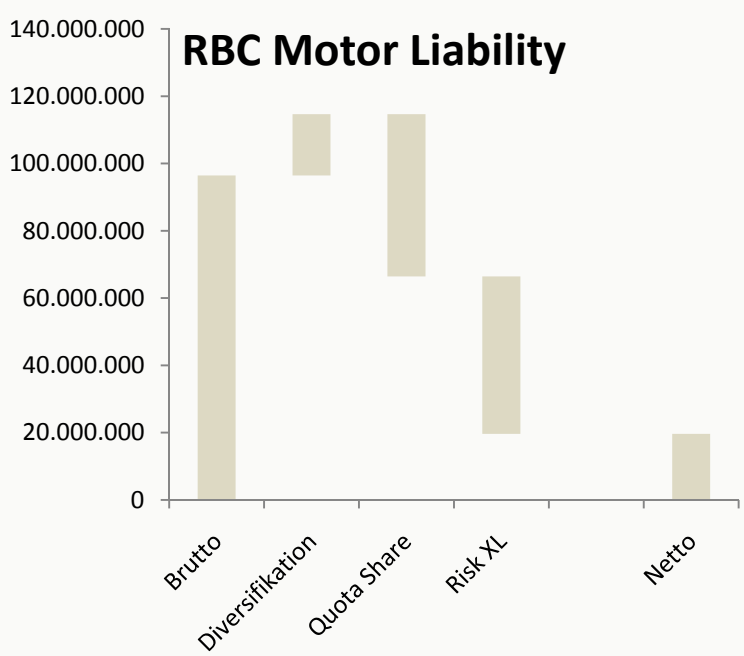
Capital Eagle: Risk situation
RBC gross vs. net





The effects of reinsurance are made obvious

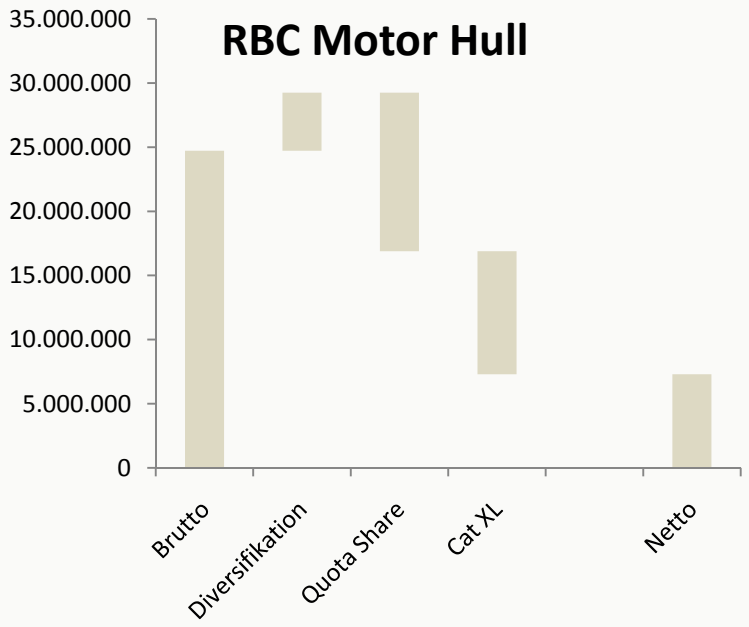
Capital Eagle
Motor Liability gross vs. net



- Risk mitigation reached by program structure
  - Attritional loss ratio fluctuation reduced by quota share
  - Large loss fluctuation reduced by Risk Excess of Loss

CapitalEagle	Motor Liability					
	premium -commission	loss expectation	st-deviation	RBC (VaR99,5)	RBC/expected	RBC/P Quote
Gross	189.242.000	170.917.303	20.323.717	96.438.041	56%	51,0%
Diversification	0	0	-3.871.561	-18.213.501		
Net	105.000.924	81.830.311	6.875.267	19.634.347	24%	18,7%
Quota Share	78.819.293	85.458.652	10.161.859	48.219.020	56%	61,2%
Risk XL	5.421.783	3.628.341	7.158.152	46.798.175	1290%	863,2%

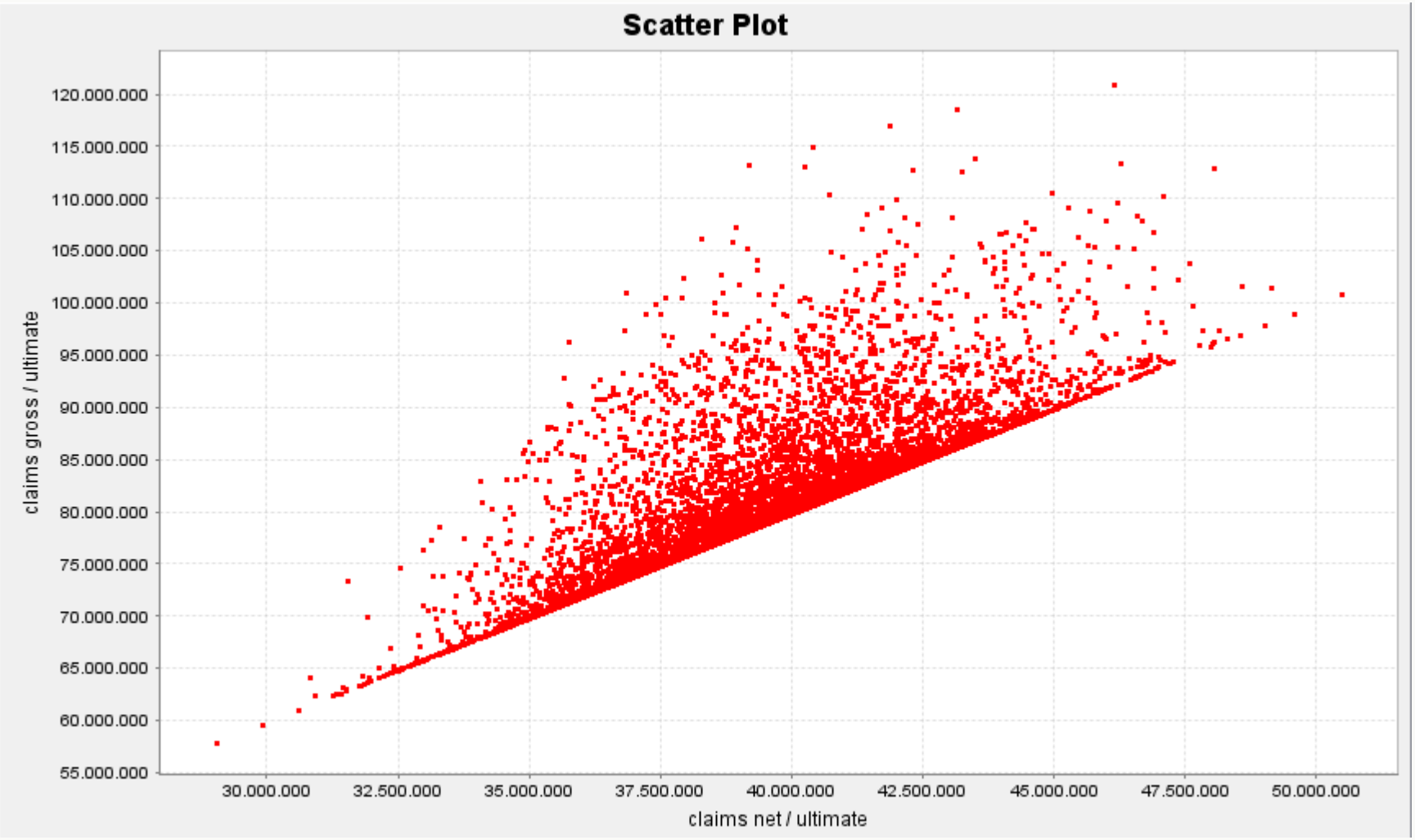
Capital Eagle
Motor Hull gross vs. net



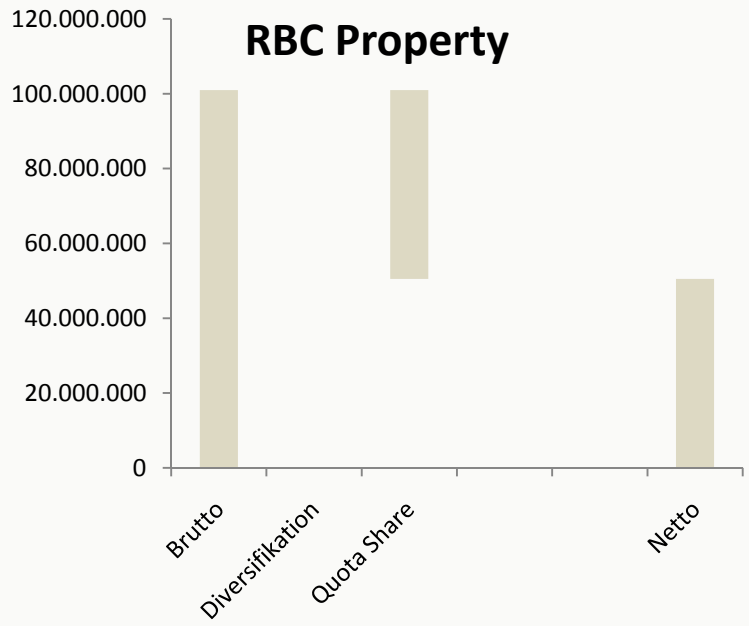
- Risk mitigation reached by program structure
  - Attritional loss ratio fluctuation reduced by quota share
  - Large loss fluctuation reduced by Catastrophe Excess of Loss

CapitalEagle	Motor Hull					
	premium -commission	loss expectation	st-deviation	RBC (VaR99,5)	RBC/expected	RBC/P Quote
Gross	97.014.000	80.715.004	7.049.173	24.615.435	30%	25,4%
Diversification	0	0	-1.234.875	-4.654.614		
Net	55.589.022	39.290.357	2.653.846	7.301.305	19%	13,1%
Quota Share	39.339.177	40.357.502	3.524.587	12.307.718	30%	31,3%
Risk XL	2.085.801	1.067.145	2.105.616	9.661.026	905%	463,2%

Capital Eagle
Motor Hull gross vs. net



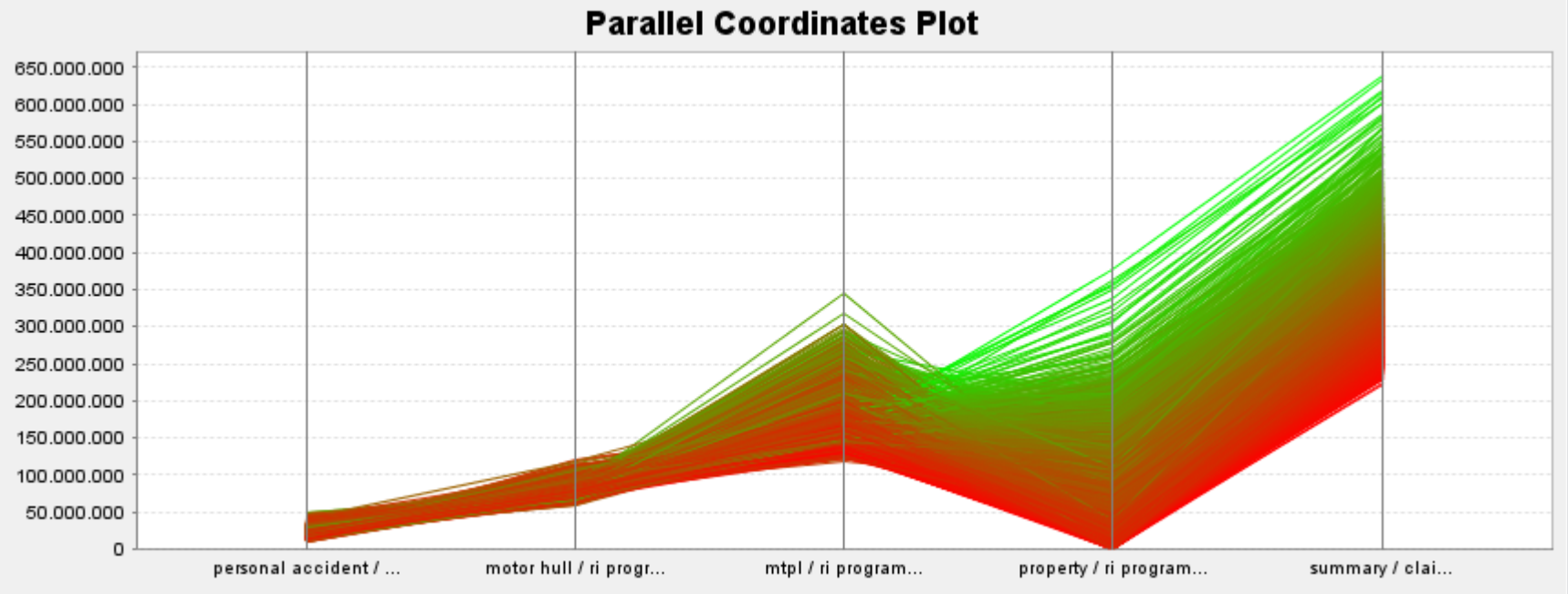
Capital Eagle
Property gross vs. net



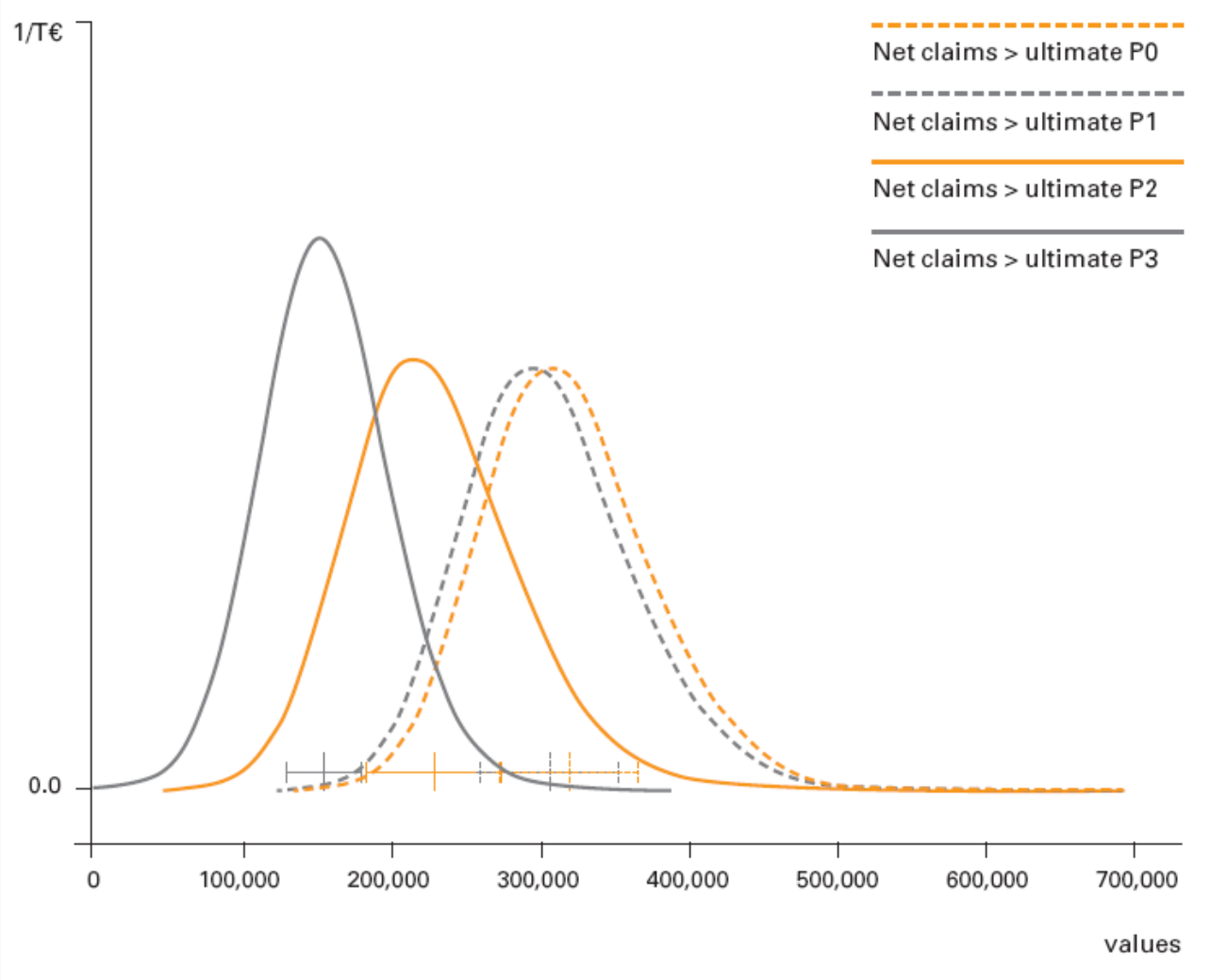
- Quota Share not sufficient in Property (compared to other Lines of business)
- Further discussion required

CapitalEagle	Property					
	Prämie + Provisionen	Schaden Erwartung	St-Abweichung	RBC (VaR99,5)	RBC/EW Quote	RBC/P Quote
Gross	72.939.000	52.584.426	21.538.236	100.979.108	192%	138,4%
Diversification	0	0	0	0		
Net	48.623.355	26.292.213	10.769.118	50.489.554	192%	103,8%
Quota Share	24.315.645	26.292.213	10.769.118	50.489.554	192%	207,6%

Capital Eagle
Gross loss in parallel coordinates chart



Capital Eagle: retained losses of reinsurance alternatives



Decision support of PODRA
Answers provided

overall annual risk situation? capital requirement of the assumed insurance policies?

- Expected value of annual aggregated loss
- Value at Risk at 99.5% confidence level

main risk drivers?

- LoB Property standalone VaR 99.5%

allocation of the overall capital requirements to individual policies?

- LoB Property contributes x% to the overall VaR 99.5%

capital relief of our reinsurance policy?

- Expected Value of annual aggregated loss
- Net Value at Risk at 99.5% confidence level

Summary: Munich Re provides support in preparation of the PODRA service

PODRA – Powered by PillarOne

PODRA (PillarOne Dynamic Reinsurance Analysis) is a service developed by Munich Re to describe and measure underwriting risk in property and casualty insurance.

The method is based on the PillarOne.RiskAnalytics software platform, an open-source software project initiated and sponsored by Munich Re. Project set-up, roadmap, features, software downloads, and other information can be found on the community website www.pillarone.org. All PillarOne applications include an open source software licence (GPL) which provides usage free of charge.