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Modelling Operational Risk for Regulatory Compliance

Introduction

Modelling

The use of the four elements

ILD and ELD

Scenario analysis

BEICF

Distribution assumptions

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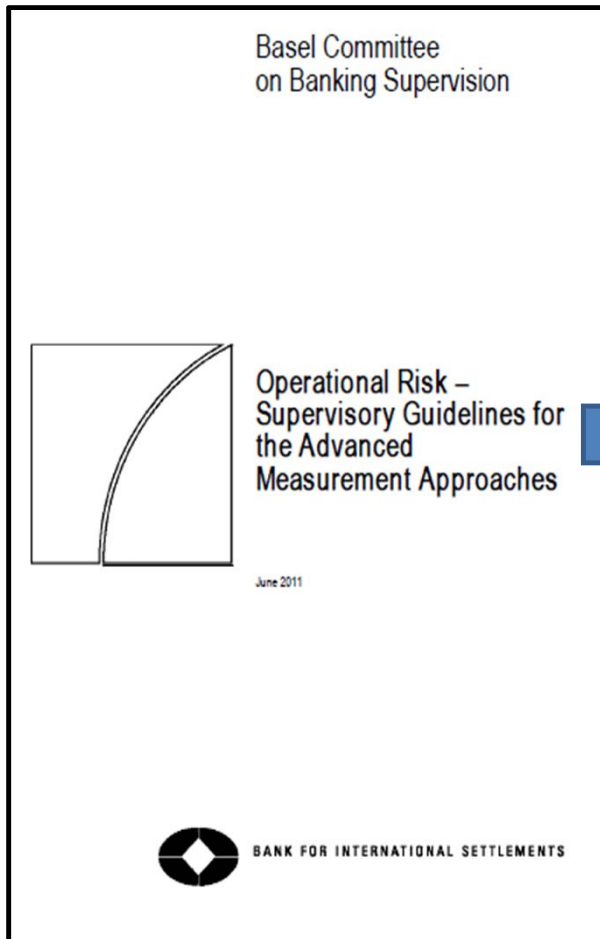
Path to AMA

AMA implementation trends

Introduction

Supervisory Guidelines for AMA

Regulatory requirements under Basel Supervisory Guidelines for operational risk capital models define some very significant needs on the software supporting the capital calculation.



Basel Committee		OpRisk Capital Software Needs	
Supervisory Guidelines for AMA			
Governance	<i>General</i>	User control: governance over modeling process and options Audit trail of data sources and their transformations Full control and understanding over statistical processes	Workflow management Integrity of data flows Reporting of capital results
	<i>Verification</i>	Reporting of modeling assumptions Automatic documentation of data sources and transformations	Replicability of results
	<i>Validation</i>	Backtesting	All verification functionalities
	<i>Use test</i>	Insurance evaluation Investment on risk mitigation business case	Reporting of capital results
Data	<i>Managed at the GRC platform</i>	Gross loss definition, thresholds, date, grouped losses, etc. Consistency with accounting	Completeness of collection
Modeling	<i>Granularity</i>	Flexible definition of business units and risk categories Capital allocation functionalities	
	<i>Distribution assumptions</i>	Threshold determination Split of distribution body and tail Light and heavy tail distributions Methodology to reduce estimates variability	Realistic capital estimates Robust methods GoF graphical and numerical Capture tail events
	<i>Joint distribution</i>	Monte Carlo Single loss approximation	
	<i>Correlation and dependence</i>	Empirical data and expert judgment Copulas	Stressing correlations
	<i>The use of the 4 elements</i>	Modeling of ILD, ELS, SA Combination of the elements	BEICF Stressing the modeling

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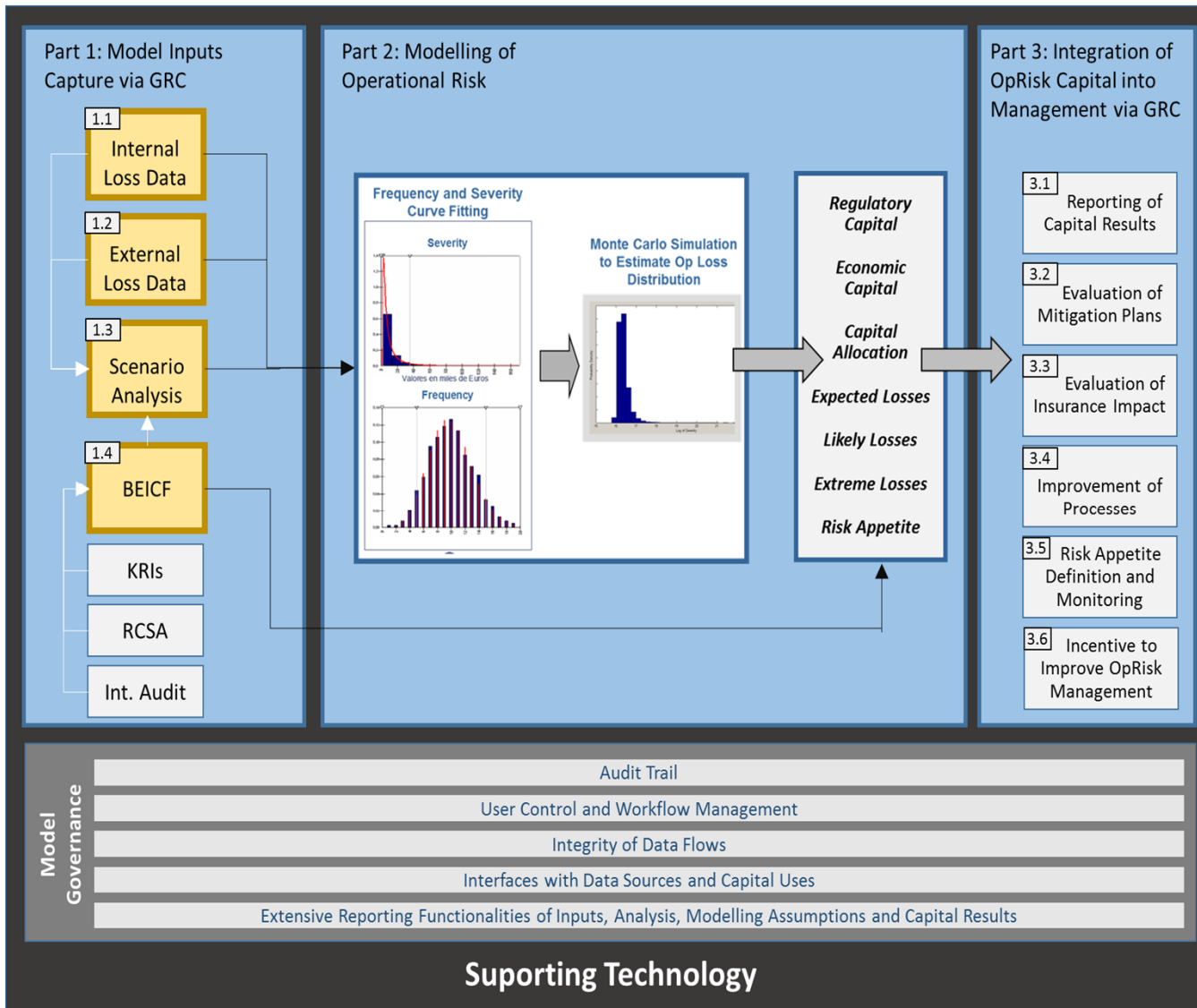
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The Use of the Four Elements: ILD, ELD, SA and BEICFs



“An AMA for calculating the operational risk capital charge of a bank requires the use of four data elements which are: (1) internal loss data (ILD); (2) external data (ED); (3) scenario analysis (SBA) and (4) business environment and internal control factors (BEICFs).”

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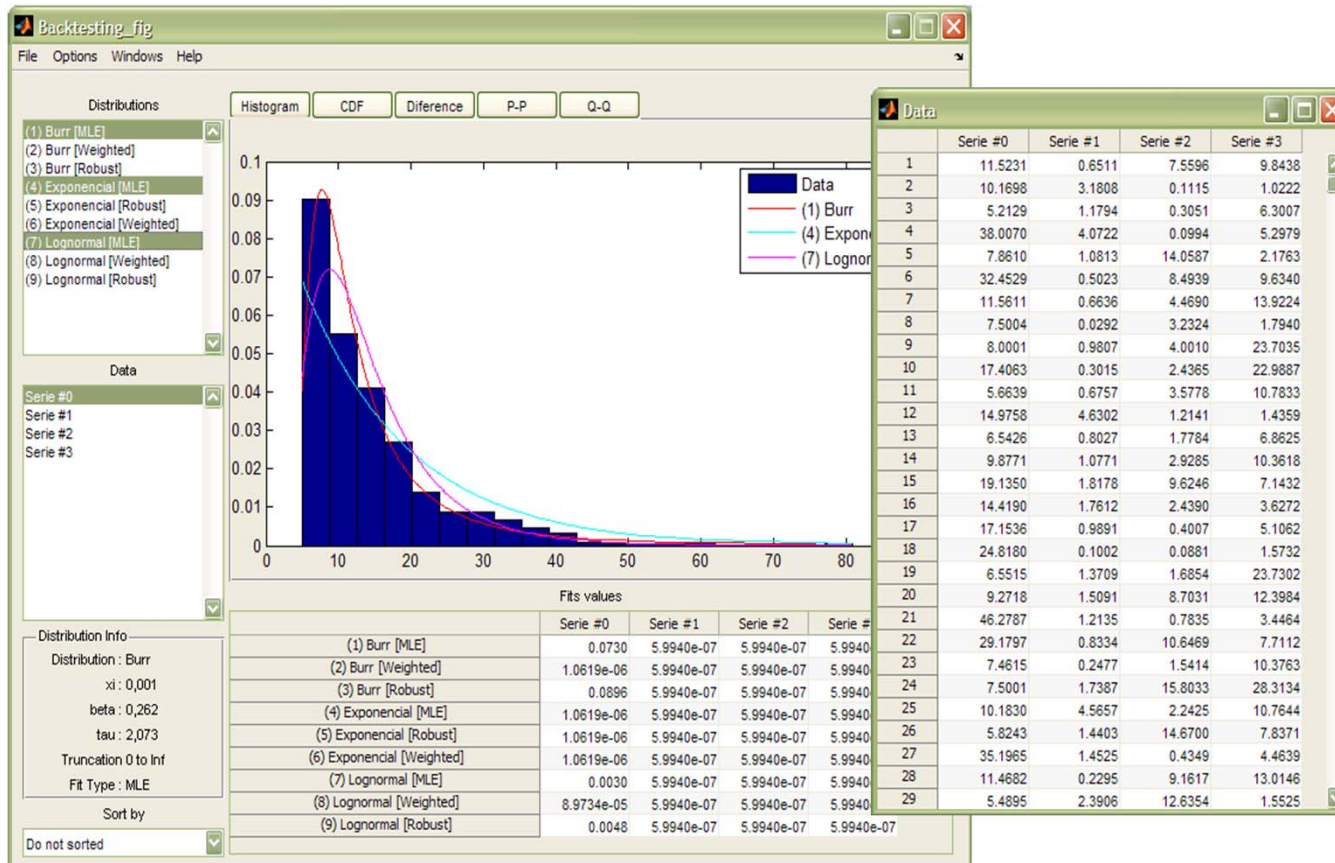
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The Use of the Four Elements: Internal Loss Data and Distribution Assumptions

Our software provides multiple distributions and the means to identify those more closely replicating the risk profile implicit in internal losses.



“Supervisors expect ILD to be used in the operational risk measurement system (ORMS) to assist in the estimation of loss frequencies; to inform the severity distribution(s) to the extent possible”.

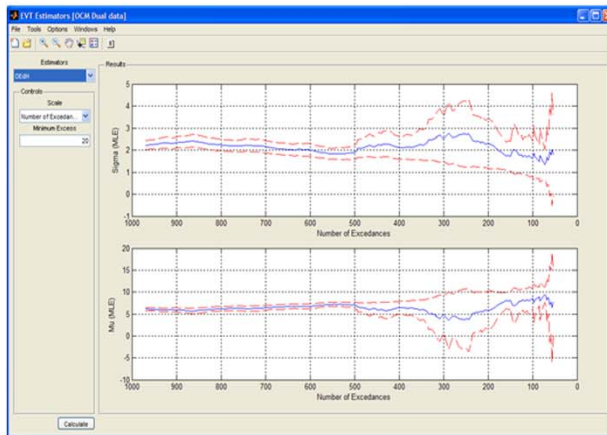
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Modelling

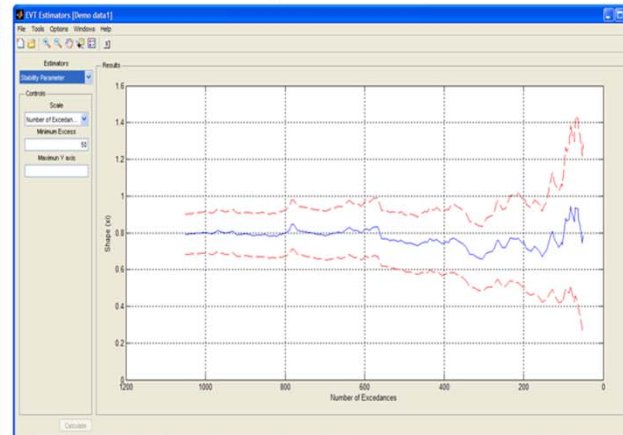
The Use of the Four Elements: Internal Loss Data and Distribution Assumptions

For Threshold and Tail Weight Determination: Hill, Mean Excess Plot, DEdH, Stability Parameter, HKKP, Tail Plot, GoF and Capital Stability by Threshold, etc.

DEdH



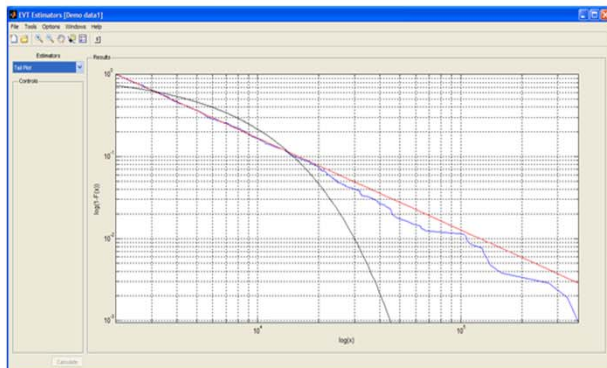
Stability Parameter



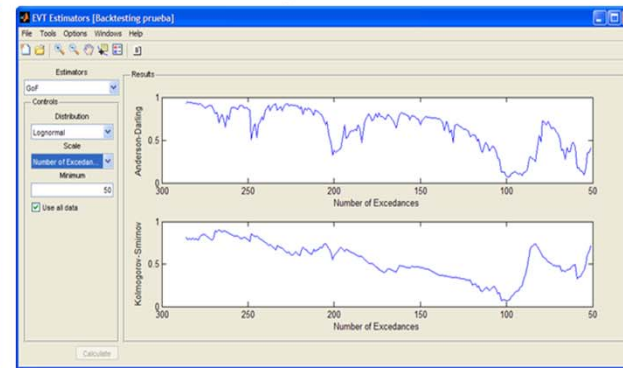
“A bank is responsible for defining and justifying appropriate thresholds for each operational risk class, both for data collection and modelling”.

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Tail Plot



GoF by Threshold



Modelling

The Use of the Four Elements: Reduce Estimates Variability and Realistic Capital Estimates

Evaluation of the Variability of Capital Estimates and GoF, Given New Losses

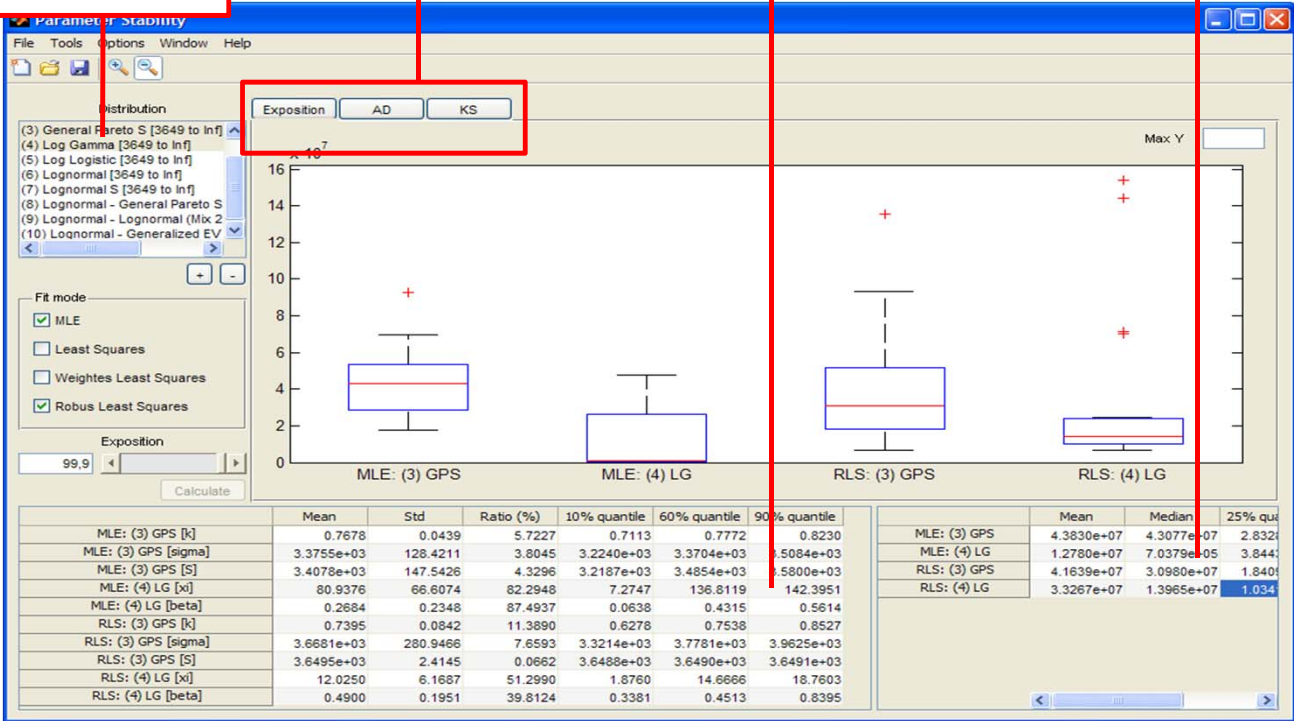
Permits to compare the parameter stability of different distributions and thresholds.

Three different box plots can be used to compare results:

- Capital estimate
- Anderson-Darling P-value
- Kolmogorov-Sm. P-value

Parameters statistics for the different distributions are showed in the bottom window table.

Capital estimates statistics are shown at the bottom window table.



“The bank should put in place methodologies to reduce estimate variability and provide measures of the error around these estimates (eg confidence intervals, p-values)”.

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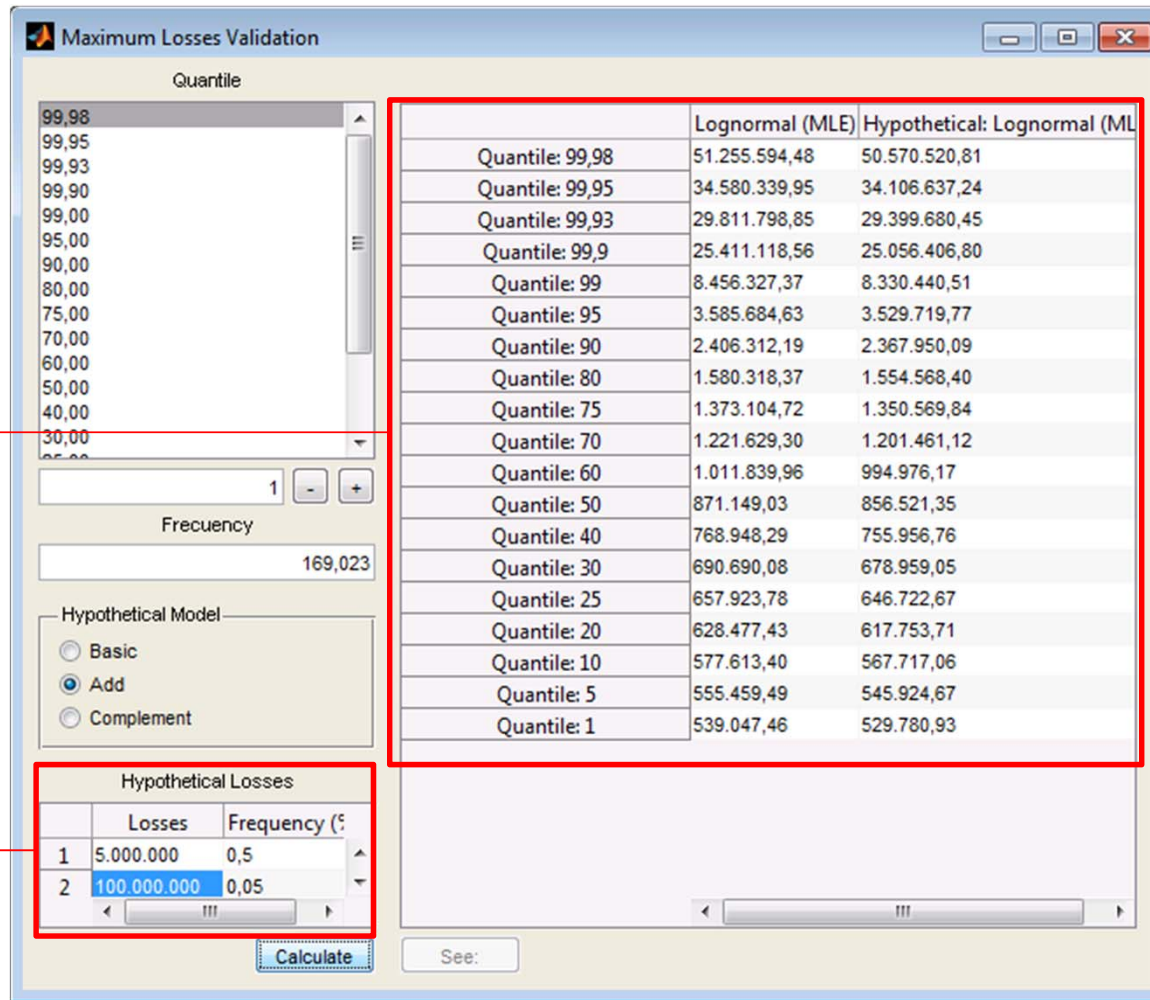
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The Use of the Four Elements: Reduce Estimates Variability and Realistic Capital Estimates

What-If Tool for the Analysis of the Realism of Capital Estimates and the Sensitivity of Capital Estimates given New Extreme Losses



New capital estimates as the result of the introduction of hypothetical new losses

Grid to introduce hypothetical losses together with the frequency to test capital stability

“It generates a loss distribution with a realistic capital requirements estimate, without the need to implement “corrective adjustments” such as caps”

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Modelling

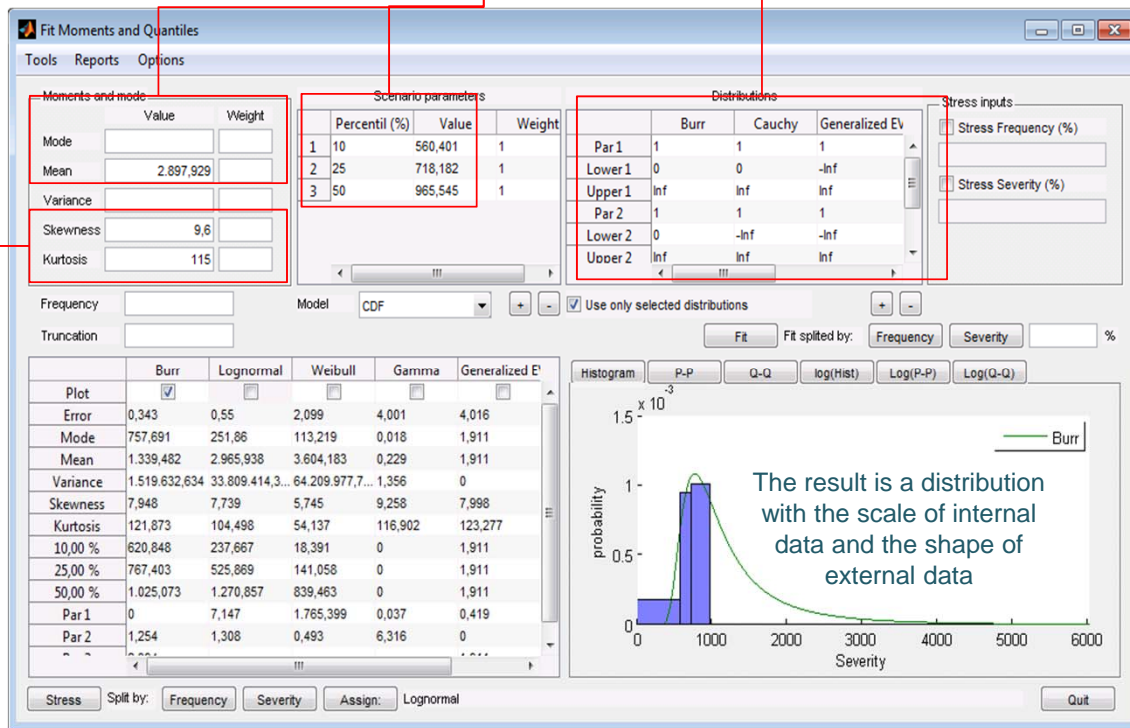
The Use of the Four Elements: External Loss Data

Integration and Rescaling of External Data

High distribution moments can be set as value targets as off the analysis of external data

Mean, mode and quantiles (arbitrary number of quantiles) may be derived from internal data

Distribution parameters (tail parameter, shape parameter, etc.) restrictions may established as off the analysis of external data



“Supervisors expect ED to be used in the estimation of loss severity as ED contains valuable information to inform the tail of the loss distribution(s) “

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“A data scaling process involves the adjustment of loss amounts reported in external data to fit a bank’s business activities and risk profile. Any scaling process should be systematic, statistically supported, and should provide output that is consistent with the bank’s risk profile”.

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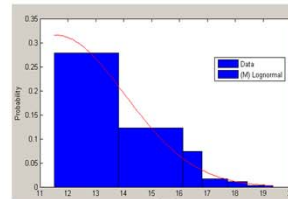
Modelling

The Use of the Four Elements: Scenario Analysis Modelling

Scenario Analysis Elicitation Methods

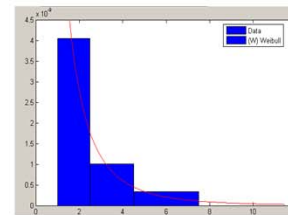
Likely Scenarios

Severity bucket	\$100K - \$500K	\$500k - \$2M	\$2M - \$5M	\$5M - \$10M	\$10M - \$25M
Number of incidents by year	25	11	2	0.6	0.3



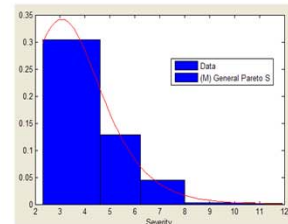
Extreme Scenarios

	In 2 years	In 5 years	In 10 years	In 20 years
Biggest loss	\$10M	\$25M	\$45M	\$75M



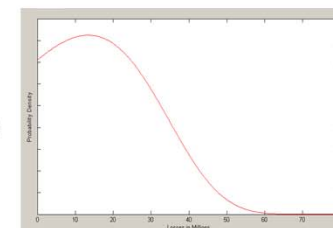
Worst loss by number of incidents

	Worst in 10 losses	Worst in 100 losses	Worst in 1,000 losses	Worst in 10,000 losses	Worst in 100,000 losses
Loss	1.000.000	1.500.000	1.700.000	1.750.000	1.790.000



R&CSA: moments plus quantiles

- Expected Loss: 30.000 €
- Severe Loss (95%): 50.000 €
- Extreme Loss (99%): 100.000 €
- Catastrophic Loss (99,9%): 150.000 €



“A robust scenario analysis framework is an important element of the ORMF. This scenario process will necessarily be informed by relevant ILD, ED and suitable measures of BEICFs”.

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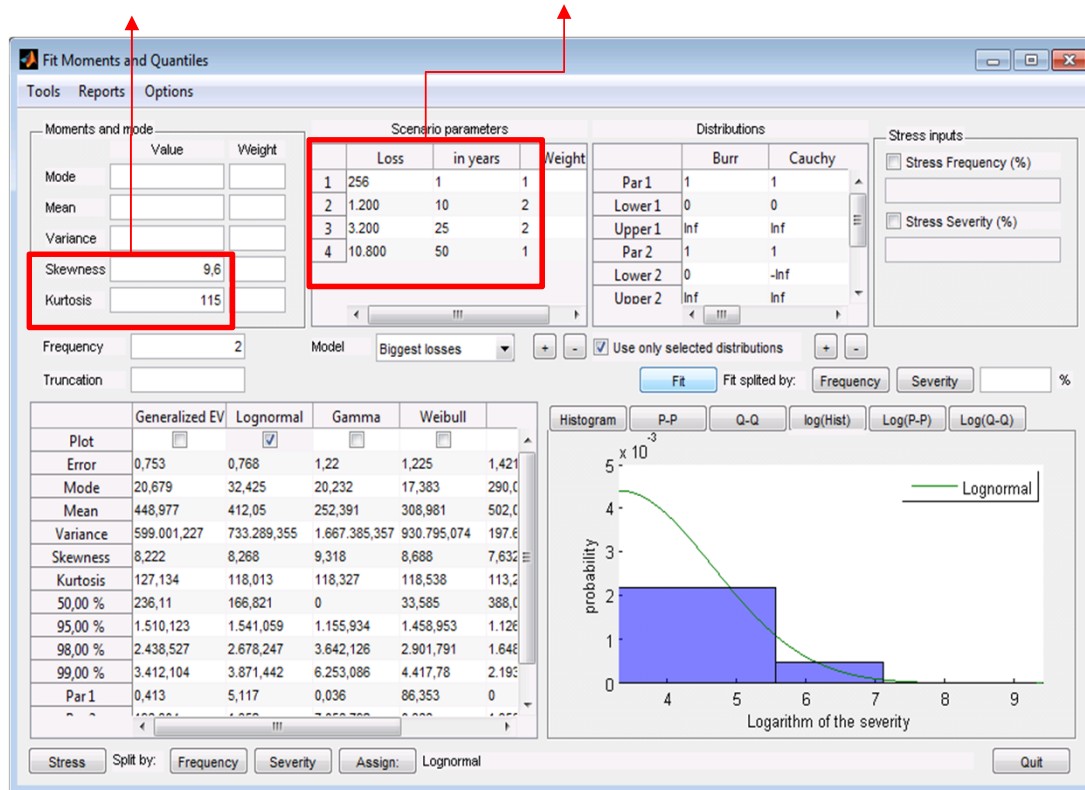
Modelling

The Use of the Four Elements: Scenario Analysis Modelling

OpCapital Precision provides the means to model scenario analysis into distributions for modelling and integrate them into the operational risk calculation. Information from external or internal data can be added such as moments, mode, percentiles, etc.

Derived from
the analysis of
external data

Answers from the
scenario analysis rating



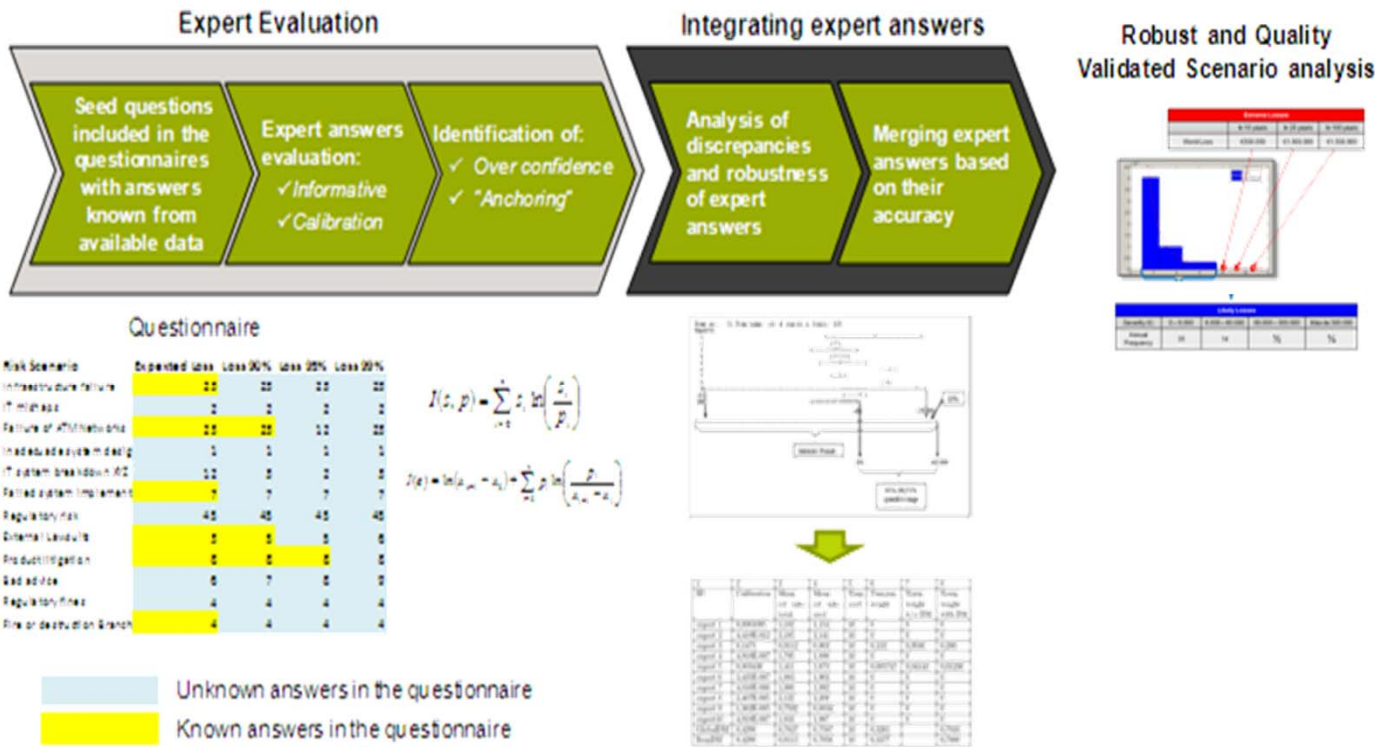
“A bank should thus ensure that the loss distribution(s) chosen to model scenario analysis estimates adequately represent(s) its risk profile”

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Modelling

The Use of the Four Elements: Scenario Analysis Validation

Performance Based Expert Judgment, for the Validation of Scenario Analysis



“A robust governance framework surrounding the scenario process is essential to ensure the integrity and consistency of the estimates produced”.

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The Use of the Four Elements: Business Environment and Internal Control Factors

Scenario Analysis Modelling Support Data

Scenario Description

Scenario Description (story line):	<input type="text"/>
Key Drivers of the Scenario	<input type="text"/>
Causal Pathway	<input type="text"/>

Risk Control Situation

Existing Key Controls	<input type="text"/>
Potential Control Gaps	<input type="text"/>
Materialized Control Failings	<input type="text"/>

Risk Mitigation

Opportunities Mitigation	<input type="text"/>
Risk Mitigation Benefits	<input type="text"/>

Description and support data

Internal Loss Data	<input type="text"/>
External Loss Data - ORX	<input type="text"/>
External Loss Data - AlgoFirst	<input type="text"/>
External Loss Data - SAS	<input type="text"/>
Previous RCSA	<input type="text"/>
Current RCSA	<input type="text"/>
KRIs for Severity	<input type="text"/>
KRIs for Frequency	<input type="text"/>
Audit results:	<input type="text"/>
Audit non conformities:	<input type="text"/>

“BEICFs are operational risk management indicators that provide forward-looking assessments of business risk factors as well as a bank’s internal control environment”.

“BEICFs are commonly used as an indirect input into the quantification framework and as an ex-post adjustment to model output”.

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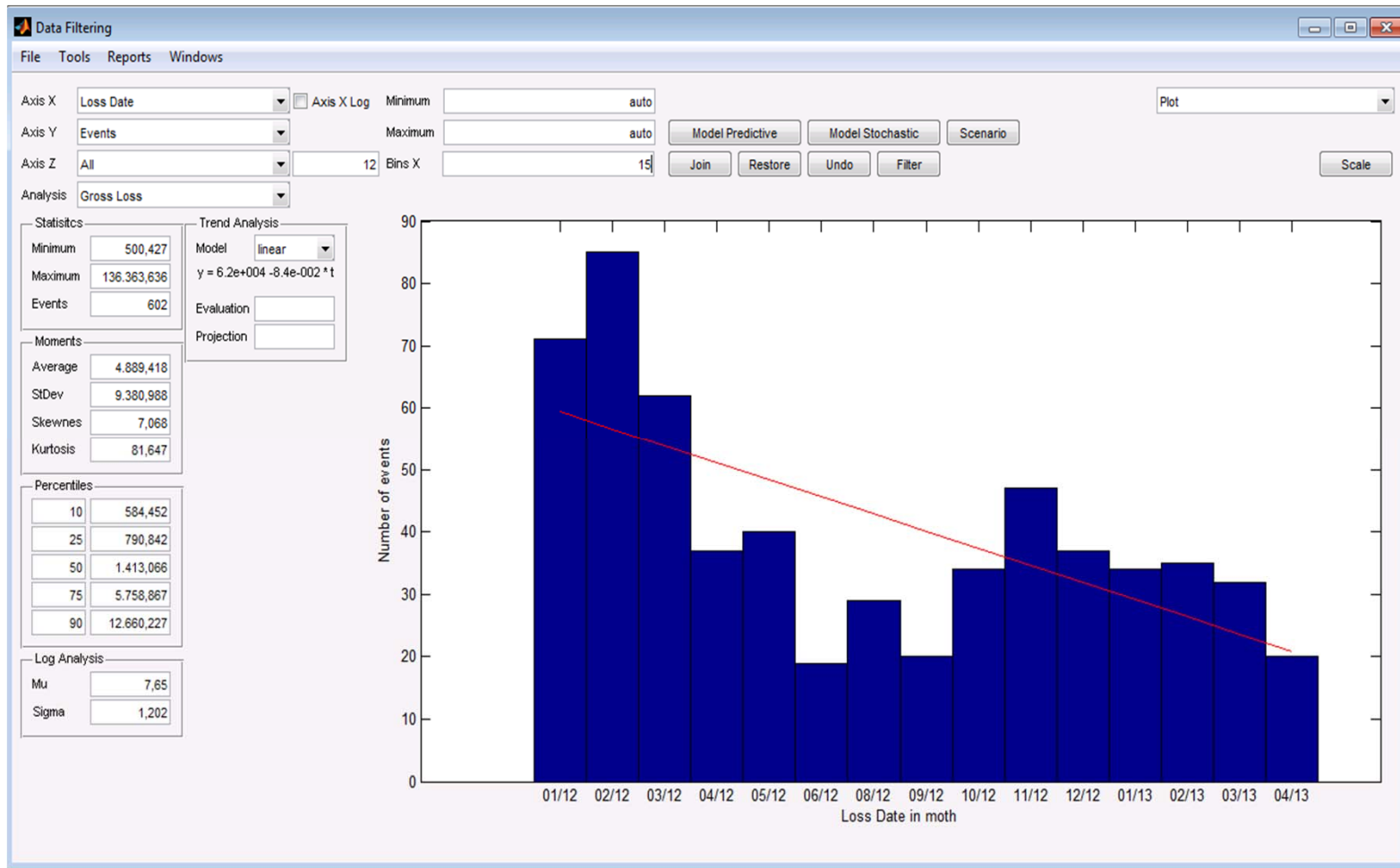
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The Use of the Four Elements: Business Environment and Internal Control Factors

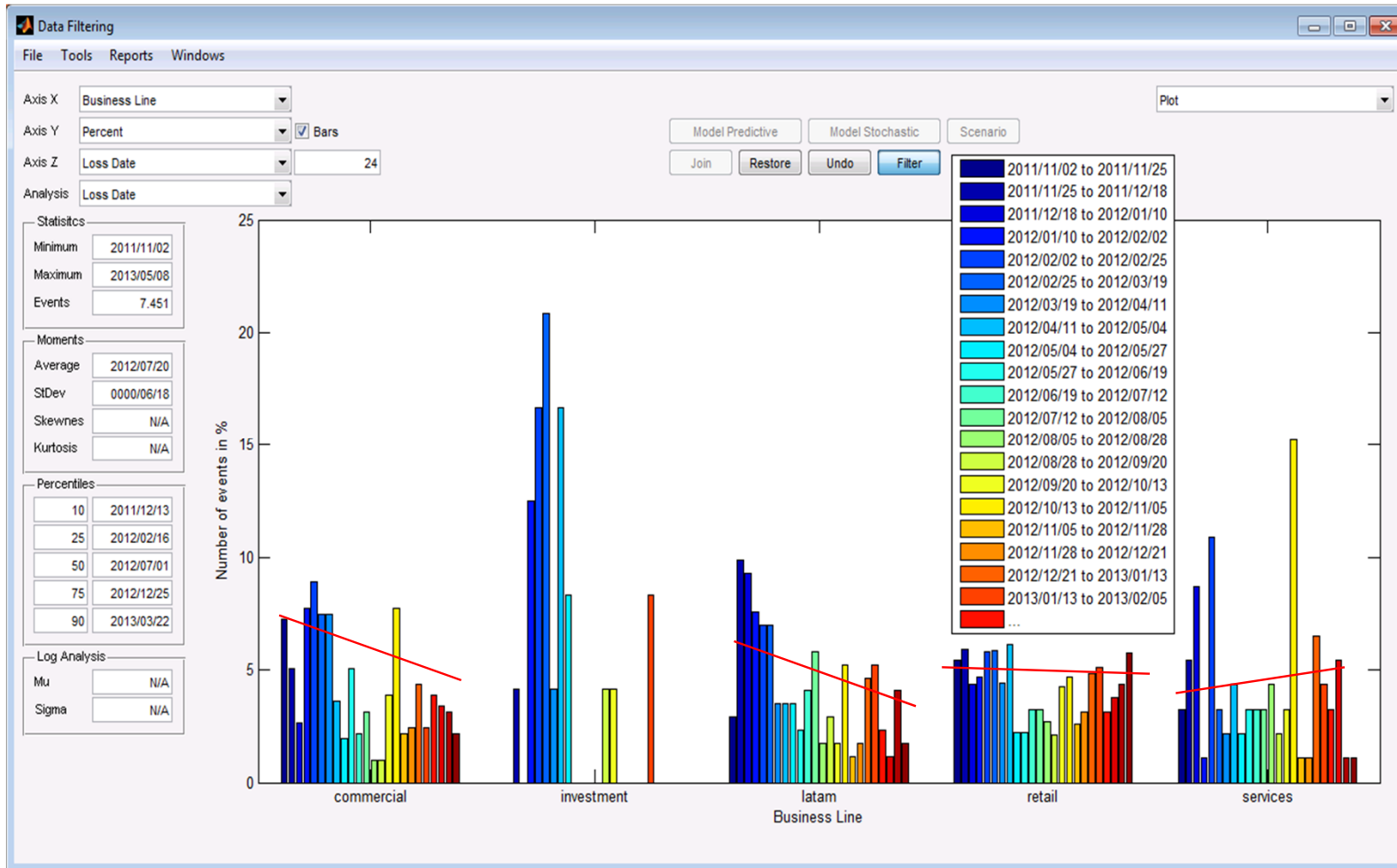
KRIs may also play a direct roll in BEICF. Below the total loss frequency by month is represented together with its down sloping trend. If the trend is stable it may indicate a improvement on the operational risk control environment



Modelling

The Use of the Four Elements: Business Environment and Internal Control Factors

Total frequency by business line can be analyzed to prove the improvement on the control environment by organizational unit and reflect it in the modelling or capital charges.



Modelling

The Use of the Four Elements: Business Environment and Internal Control Factors

BEICF can also be used to incentive behaviors via capital charges. Capital can be adjusted ex-post based on performance by business units

BEICFs as *ex-post* adjustment to model outputs

“BEICFs are commonly used as an indirect input into the quantification framework and as an ex-post adjustment to model output”.

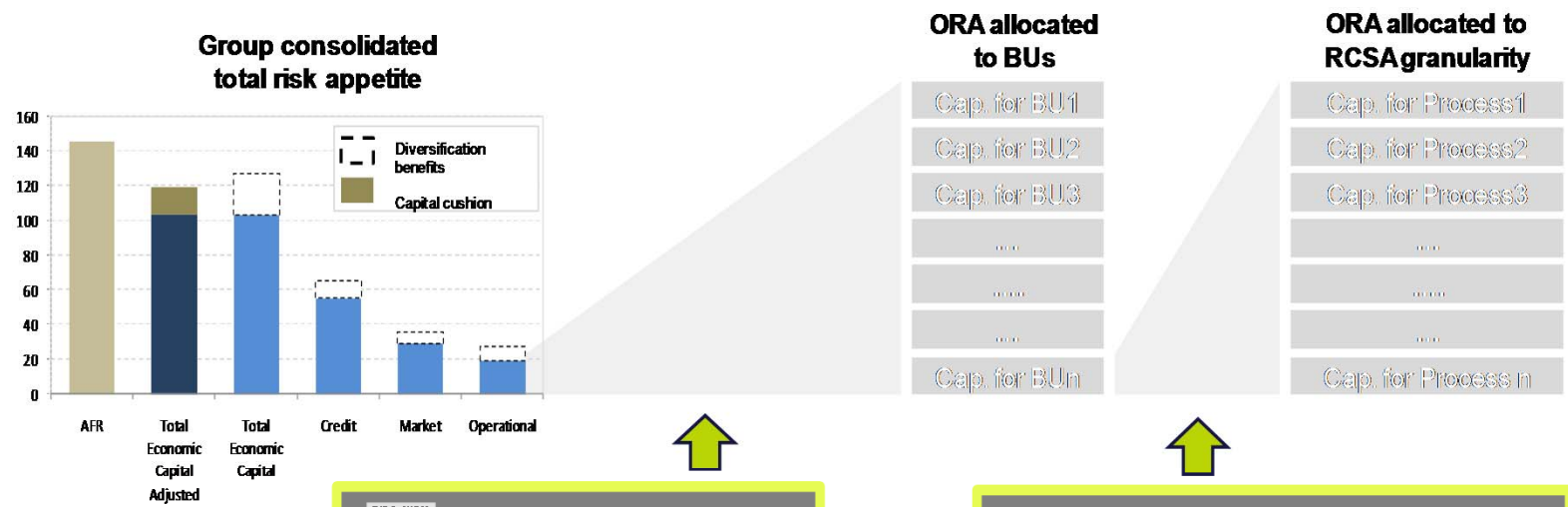
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		CIB				PBB				Africa						
		Score	Threshold %			Capital Add-on	Score	Threshold %			Capital Add-on	Score	Threshold %			Capital Add-on
			<60	60-75	>75			<60	60-75	>75			<60	60-75	>75	
IMPLEMENTATION	Scenario	55%			20%	65%			0%	49%			20%			
	R&SCA	68%			0%	50%			20%	49%			20%			
	KRI	78%			-5%	65%			0%	57%			20%			
	Action Plans	71%			0%	58%			20%	54%			20%			
	Capital Add-on	15%				40%				80%						
		% chage from previous year		Capital Add-On	% chage from previous year		Capital Add-On	% chage from previous year		Capital Add-On						
Op LOSS EVOLUTION	Total Loss	-11%		-5%	9%		18%	-3%		-1%						
	Frequencies	-31%		-15%	-15%		-8%	-78%		-39%						
	Capital Add-on	-10%			5%			-20%								
TOTAL	Final Capital Add-on	5%				45%				60%						

Modelling

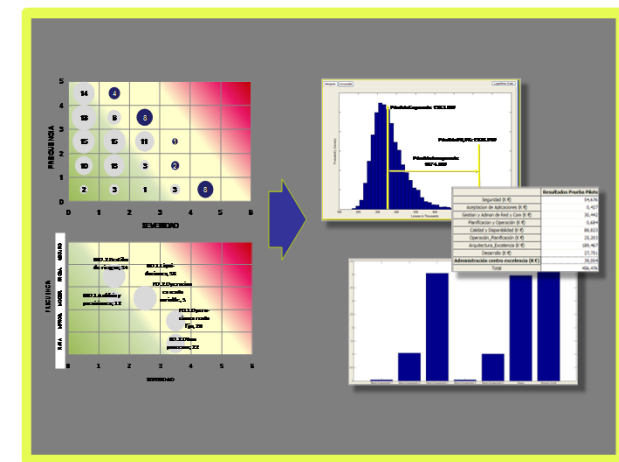
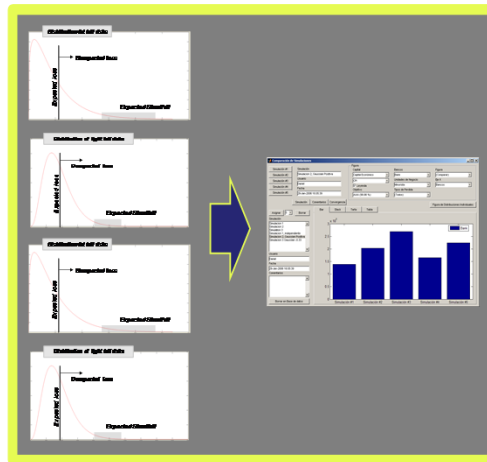
The Use of the Four Elements: Business Environment and Internal Control Factors

Institutions use BEICF to allocate capital to business units, lower levels down to areas, processes, activities, etc. using score cards, RCSA, etc.



“A bank’s board of directors should approve and review a clear statement of operational risk appetite and tolerance”.

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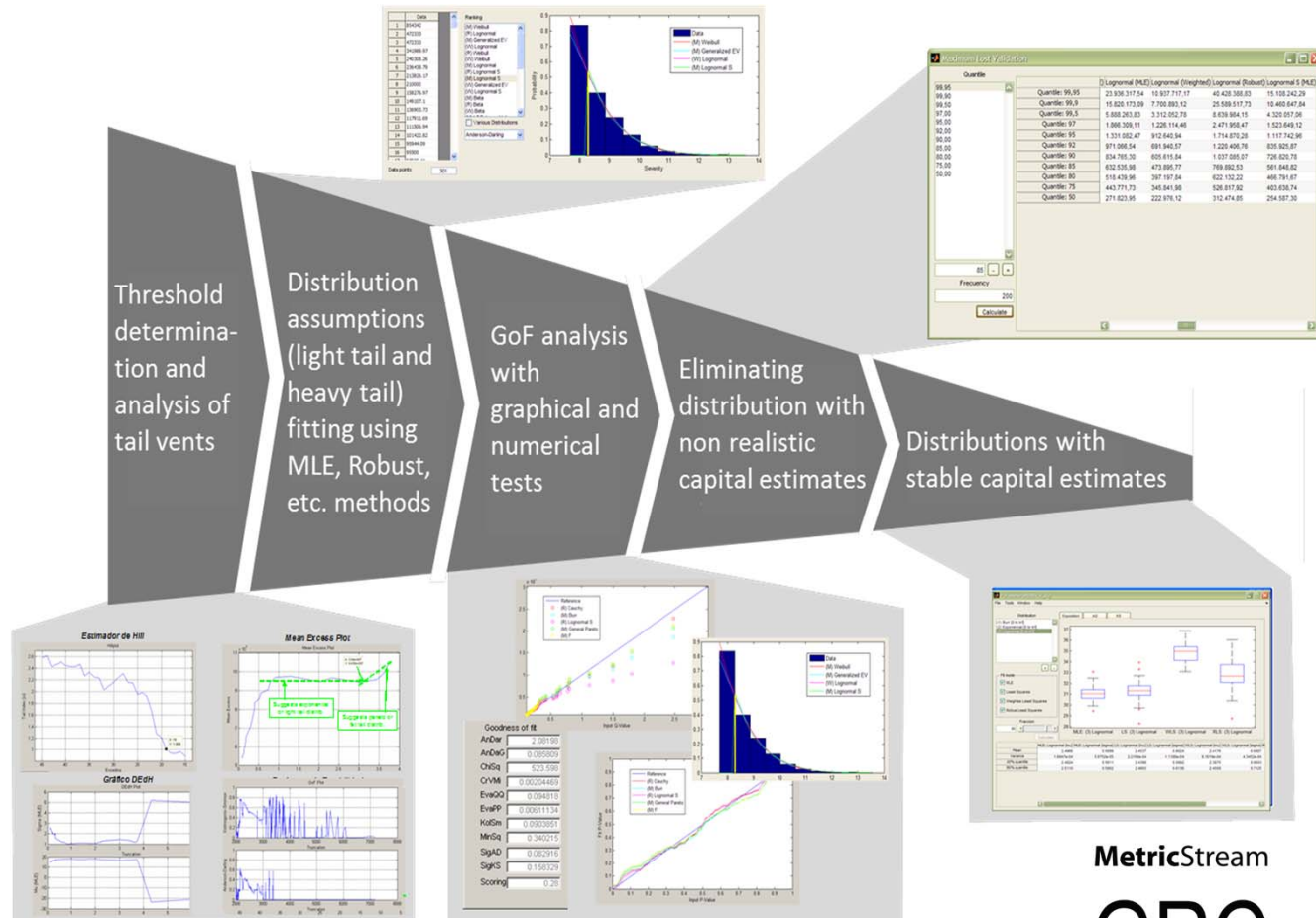
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Modelling

Distribution Assumptions

“The bank should follow a well specified, documented and traceable process for the selection, update and review of probability distributions and the estimate of its parameters”

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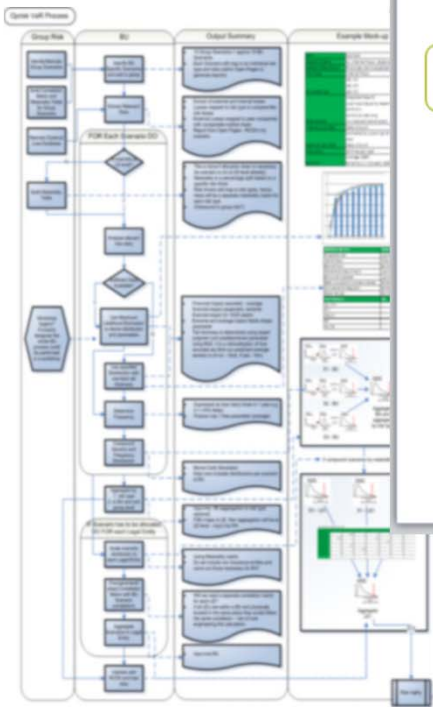
Modelling

Distribution Assumptions

In addition to provide you with a state of the art OpRisk modelling software, we can help you to define a precise modelling process, give you the required modelling training, extensive methodological documentation and support your institution all the way to the regulatory model approval

Tutorial Documentation

Modeling Process Definition in Detail



Event Data Modelling/ Defining Dataset

Data Treatment


Filtering for a case study

1. If we try to carry out an algorithmic calculation (such as when we select "Axis X log") the program will check to see if negative and 0 values exist, and notify us. If it can plot the "X axis log" it means it has no negative values and we move on.

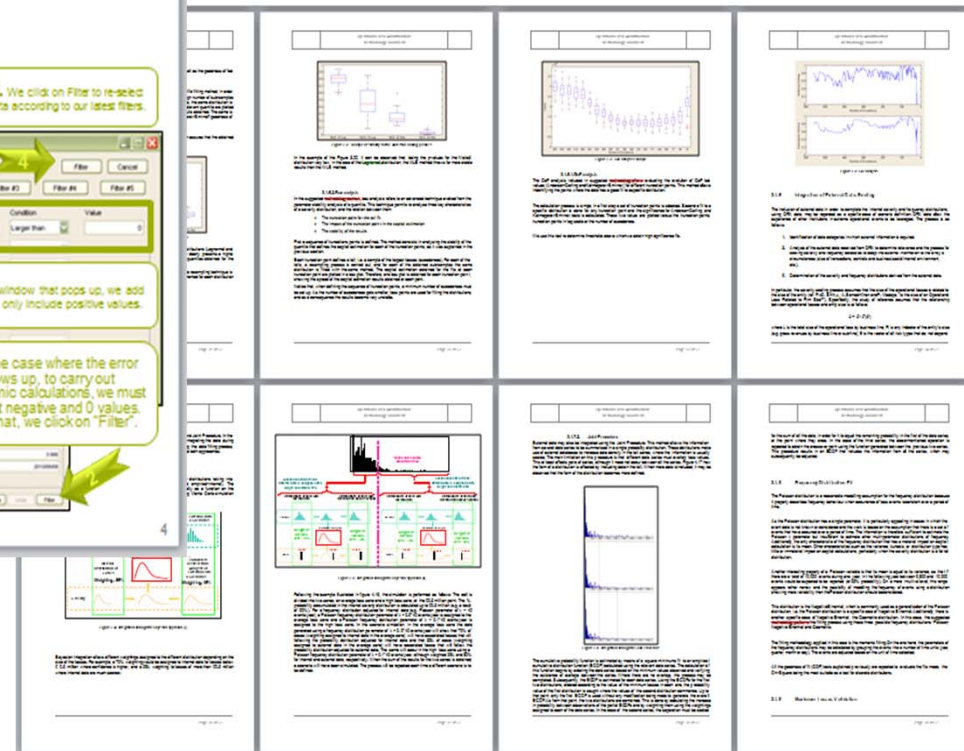
2. In the case where the error shows up, to carry out logarithmic calculations, we must filter out negative and 0 values. To do that, we click on "Filter".

3. In the window that pops up, we add the rule to only include positive values.

4. We click on Filter to re-select data according to our latest filter.



Methodology Documentation



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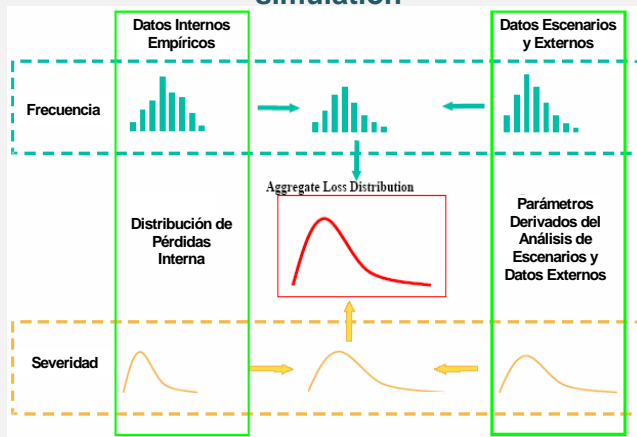
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Modelling

The Use of the Four Elements: Combining the Four Elements

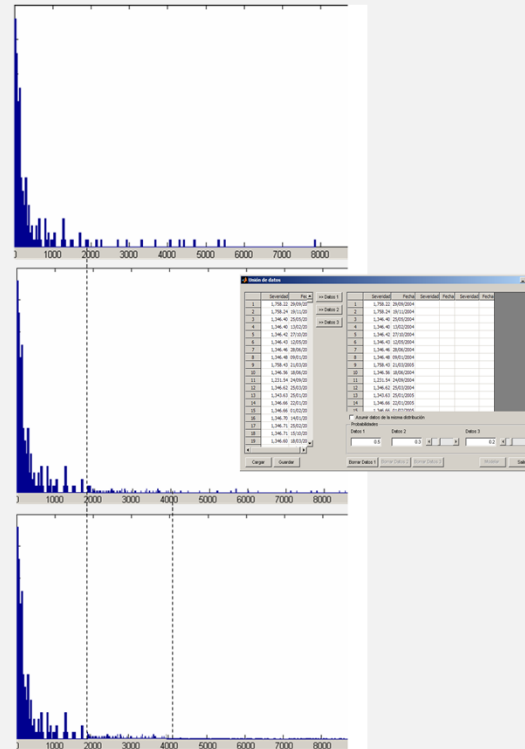
Methods for the Combination of the Four Elements

Bayesian Approach: external and internal data distributions are merged during Monte Carlo simulation



Medium losses		Internal losses (medium)		Internal losses (high)		Risk scenarios (medium)		Risk scenarios (high)		External data (medium)		External data (high)	
Weight Risk scenarios (%)	0												
Weight External data (%)	0												
High losses		Internal losses (medium)		Internal losses (high)		Risk scenarios (medium)		Risk scenarios (high)		External data (medium)		External data (high)	
Weight Risk scenarios (%)	50												
Weight External data (%)	0												
Distribution #1	Empirical	Burr	Burr	Burr	Lognormal	Distribution #2	Empirical	Burr	Burr	Burr	Lognormal	Distribution #3	Empirical
Mixture	1	1	1	1	1	Mixture	1	1	1	1	1	Mixture	1
Parameter L1.0	0	0.007	0.007	0.007	17.158	Parameter L1.0	0	0.007	0.007	0.007	17.158	Parameter L1.0	0
Parameter L1.2	0	1,311.896	1,311.896	1,311.896	0.533	Parameter L1.2	0	1,311.896	1,311.896	1,311.896	0.533	Parameter L1.2	0
Parameter L1.3	0	1.271	1.371	1.371	0	Parameter L1.3	0	1.271	1.371	1.371	0	Parameter L1.3	0
Parameter L1.4	0	0	0	0	0	Parameter L1.4	0	0	0	0	0	Parameter L1.4	0
Parameter L2.0	0	0	0	0	0	Parameter L2.0	0	0	0	0	0	Parameter L2.0	0
Parameter L2.1	0	0	0	0	0	Parameter L2.1	0	0	0	0	0	Parameter L2.1	0
Parameter L2.2	0	0	0	0	0	Parameter L2.2	0	0	0	0	0	Parameter L2.2	0
Parameter L2.3	0	0	0	0	0	Parameter L2.3	0	0	0	0	0	Parameter L2.3	0
Parameter L2.4	0	0	0	0	0	Parameter L2.4	0	0	0	0	0	Parameter L2.4	0
Parameter F1	Frequency	Poisson	Poisson	Poisson	Poisson	Parameter F1	Frequency	Poisson	Poisson	Poisson	Poisson	Parameter F1	Frequency
Parameter F1	6,985.667	112.024	4.642	4.642	4.642	Parameter F1	6,985.667	112.024	4.642	4.642	4.642	Parameter F1	6,985.667
Parameter F2	0	0	0	0	0	Parameter F2	0	0	0	0	0	Parameter F2	0
Sig A-D	0	0.483	0.483	0.483	0.106	Sig A-D	0	0.483	0.483	0.483	0.106	Sig A-D	0
Sig K-D	0	0.921	0.921	0.921	0.002	Sig K-D	0	0.921	0.921	0.921	0.002	Sig K-D	0

Actuarial Approach: empirical distributions are enriched with external data given tail, and based on differentiated weights



“A bank should carefully consider how the data elements are combined and used to ensure that the bank’s operational risk capital charge is commensurate with its level of risk exposure”.

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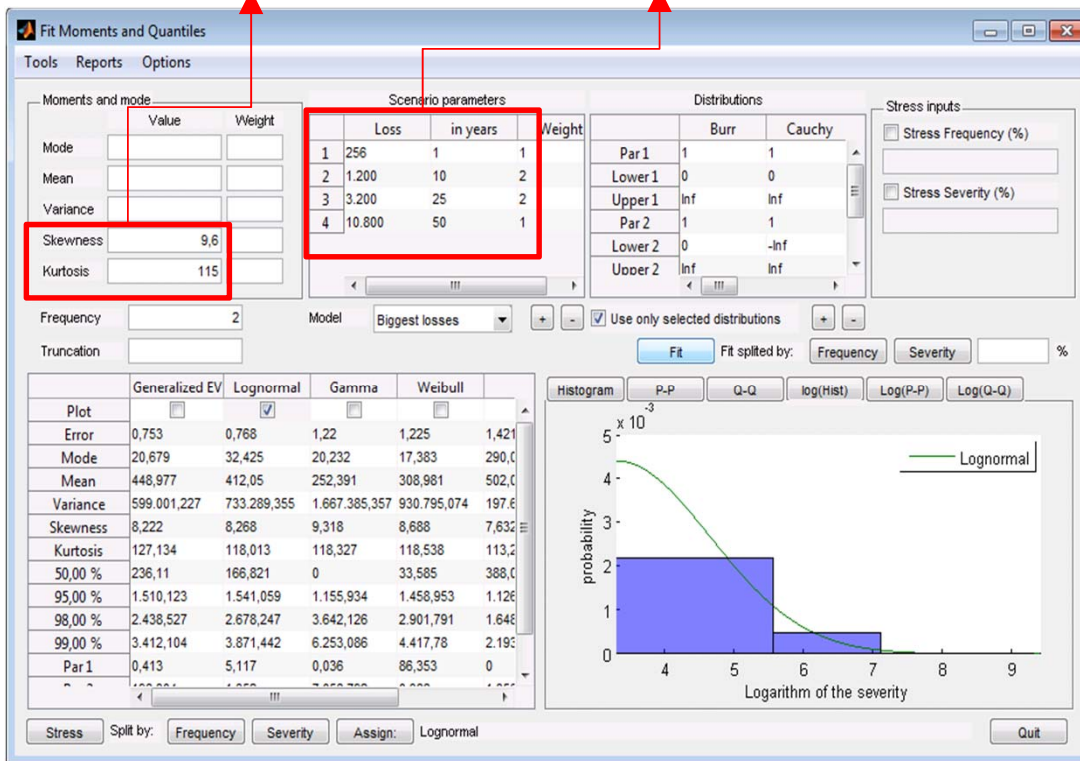
Modelling

The Use of the Four Elements: Combining the Four Elements

Methods for the Combination of the Four Elements: Fitting a Distribution with Inputs from Different Elements (ELD+ILD, ELD+SBA, etc.)

Derived from the analysis of external data

Answers from the scenario analysis rating



“The combination of data elements should be based on a sound statistical methodology”.

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Modelling

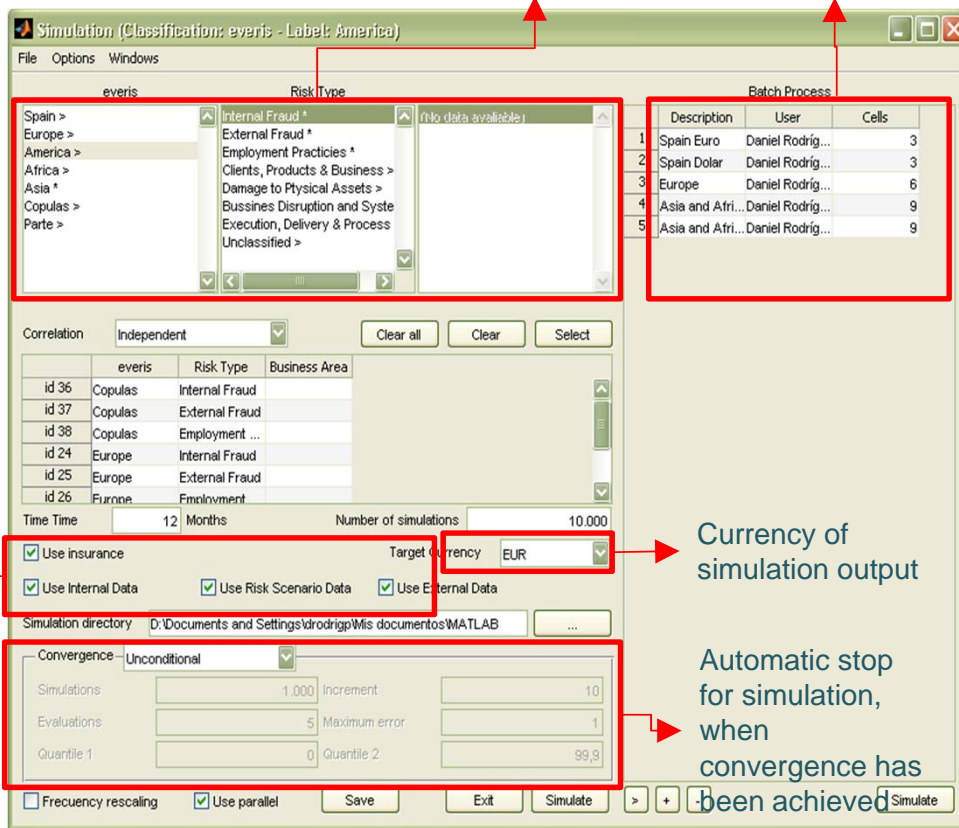
Joint Distribution

Different Features of the Monte Carlo Simulation

Components to be included in simulation: internal data, external data, scenario analysis

Selection of cells to be simulated

Batch of sequential simulations with different characteristics



"The techniques to determine the aggregated loss distributions should ensure adequate levels of precision and stability of the risk measures".

"As such, simulation, numerical or approximation methods are necessary to derive aggregated curves (eg Monte Carlo simulations, Fourier Transform-related methods, Panjer algorithm and Single Loss Approximations).

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Correlation and Dependence

Modules for the Correlation and Dependence Determination

Correlations may be calculated keldall Tau, Spearman rho and multi variant MLE for Gaussian and t-Student copulas

Correlations between calculated based on different methods may be compared, including matrixes after transformation to positive semi-definitive

Calculate correlation matrix

Calculation options

Group by: Month

Data origin: Internal

Initial date: 2003/01/02

Final date: 2011/01/21

Method: Spearman's rho

Correlation Matrix

	id 87	id 88	id 104
id 87	1	0,563	-0,256
id 88	0,563	1	-0,358
id 104	-0,256	-0,358	1

Previous Matrix (2) Kendall tau

	id 87	id 88	id 104
id 87	1	0,189	-0,024
id 88	0,189	1	-0,095
id 104	-0,024	-0,095	1

Validate

	Risk Type I	Risk Type II	Business Function
87	DEMO retail	Internal Fraud	
88	DEMO retail	External Fraud	
104	DEMO retail	Business Dis...	

Apply Cancel

“The bank may be permitted to use internally determined correlations in operational risk losses across individual operational risk estimates, provided it can demonstrate to the satisfaction of the national supervisor that its systems for determining correlations are sound, implemented with integrity and take into account the uncertainty surrounding any such correlation estimates (particularly in periods of stress). The bank must validate its correlation assumptions using appropriate quantitative”.

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Granularity

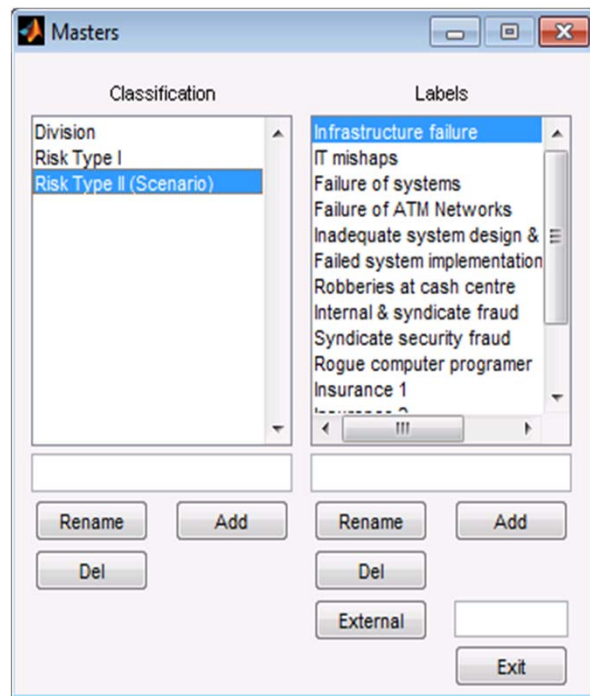
“An AMA bank’s risk measurement system “must be sufficiently granular to capture the major drivers of operational risk affecting the shape of the tail of the loss estimates”.

“When modelling operational risks, a bank should ensure that the model takes into account the bank’s idiosyncrasies.”

“Capital allocation to internal business lines should be a factor when choosing ORCs, as these ORCs may be used as part of the capital allocation process”.

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Module for Defining Granular ORCs, BUs, etc.



Capital Allocation Methodologies to Allocate Capital to the Required Granularity

Methodology	Application
<i>Contribution to Unexpected Loss</i>	<i>Where is the more probability to have a loss in the medium term? It attributes the capital where the more probability to experience an increase of losses.</i>
<i>Contribution to Expected Shortfall</i>	<i>Where are the strongest potential losses? What exposures increase more capital requirements? It's determined based the contribution of the extreme loss or tail risk (determined based on the average losses included in a pre-established confidence interval).</i>
<i>Analysis of the Incremental Capital</i>	<i>How would change may capital consumption the sale of this business line? It's appropriate for analyzing the impact on operational risk of a whole business lines and estimating the impact of closing their activities</i>
<i>Stand-Alone Allocation</i>	<i>Intuitive attribution based on the stand alone contribution to risk. Nevertheless, it does not take into consideration the diversification effects when attributing capital.</i>
<i>Euler Allocation</i>	<i>Theoretically correct answer to capital allocation although difficult to apply in practice as it requires a very large number of scenarios, for a precise answer, particularly when fat tail distributions are used.</i>

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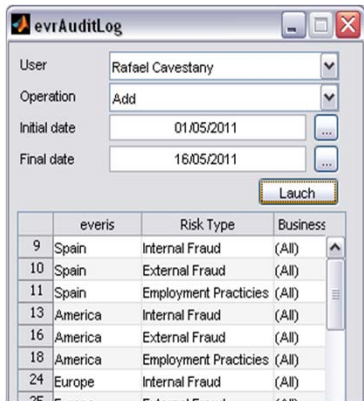
Governance

Verification and Validation

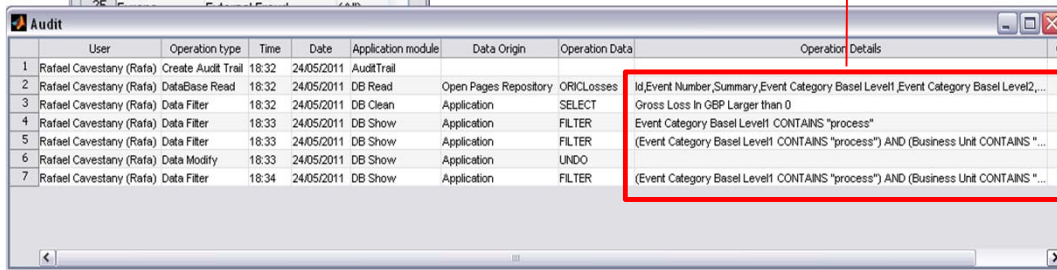
“Verification activities test the effectiveness of the overall ORMF, consistent with policies approved by the board of directors, and also test ORMS validation processes to ensure they are independent and implemented in a manner consistent with established bank policies.”

Basel Committee on Banking Supervision

Audit Trail of Modelling Assumptions

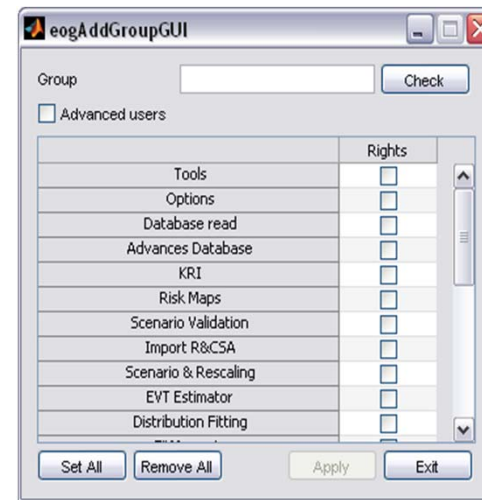


All sources transformations on inputs (ILD, ELD and SBA) are automatically recorded

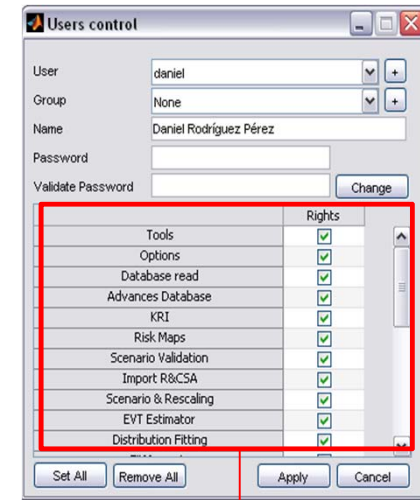


User Control for Governance and Workflow Management

Profile/group definition



User management



The rights of each user can be defined in detail, creating different users, groups and permitting a workflow management

MetricStream

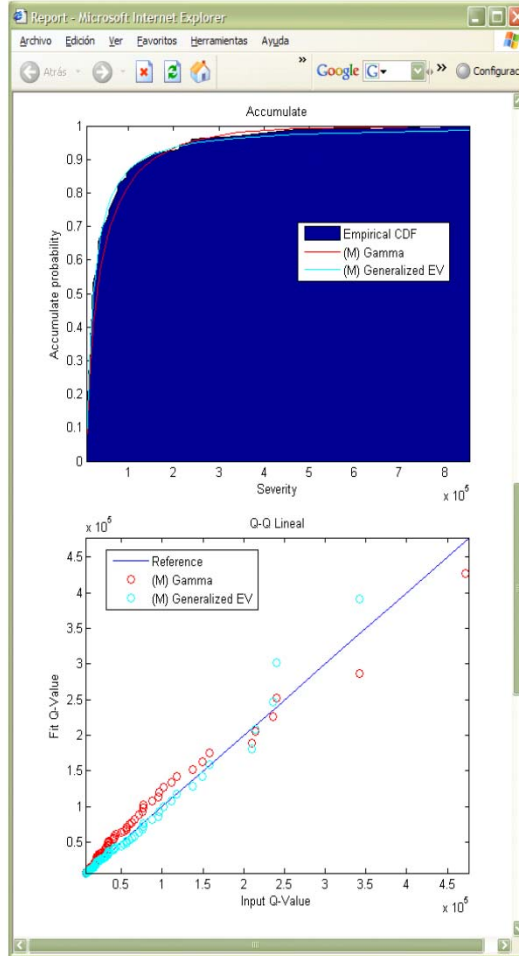
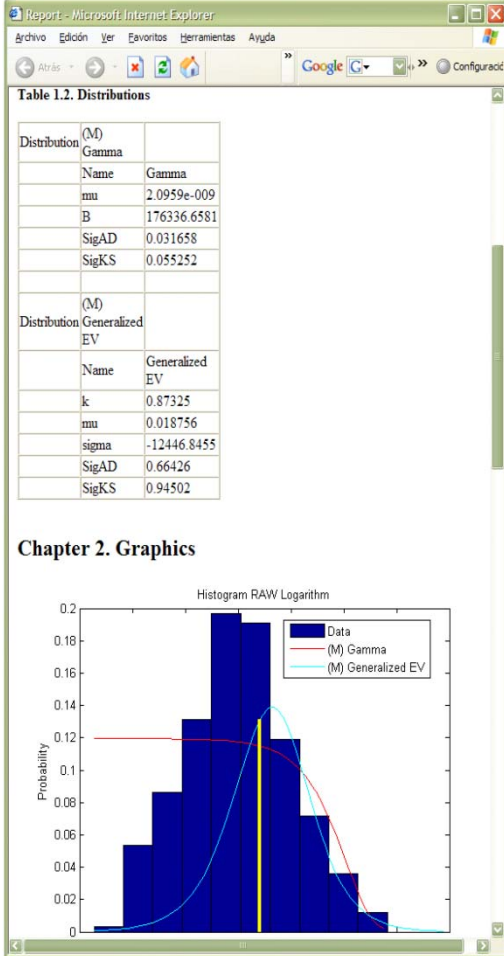
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Verification and Validation

Reporting of Modelling Assumptions



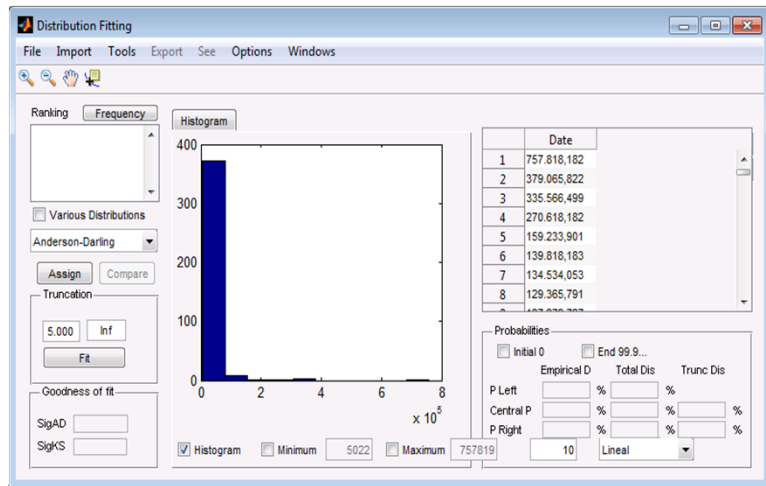
“Results from verification and validation work should be documented and distributed to appropriate business line management, internal audit, the corporate operational risk management function and appropriate risk committees. Bank staff ultimately responsible for the validated units should have access to, and an understanding of, these results”.

Basel Committee on Banking Supervision

Governance

Verification and Validation

The possibility to replicate results will also permit to verify on-the-fly all the modelling intermediate and final outputs.



Business Line	Risk Type I	Scenario	Modeling Year	Project Number	Region	Truncation
81 Retail Banking	Clients, Prod.	(All)	(All)	(All)	(All)	OK
82 (All)	(All)	(All)	(All)	(All)	(All)	OK
83 Demo	cibercrime	(All)	(All)	(All)	(All)	OK

Governance

Verification and Validation

OpCapital Precision provides a specific module for backtesting to the modelling, including scenario analysis with new and old internal and external loss data, etc.

"Verification of the ORMF includes testing whether all material aspects of the ORMF have been implemented effectively ...: ...a comparison of scenario results with internal loss data and external data".

Basel Committee on Banking Supervision

"Validation ensures that the ORMS used by the bank is sufficiently robust and provides assurance of the integrity of inputs, assumptions, processes and outputs".

Basel Committee on Banking Supervision

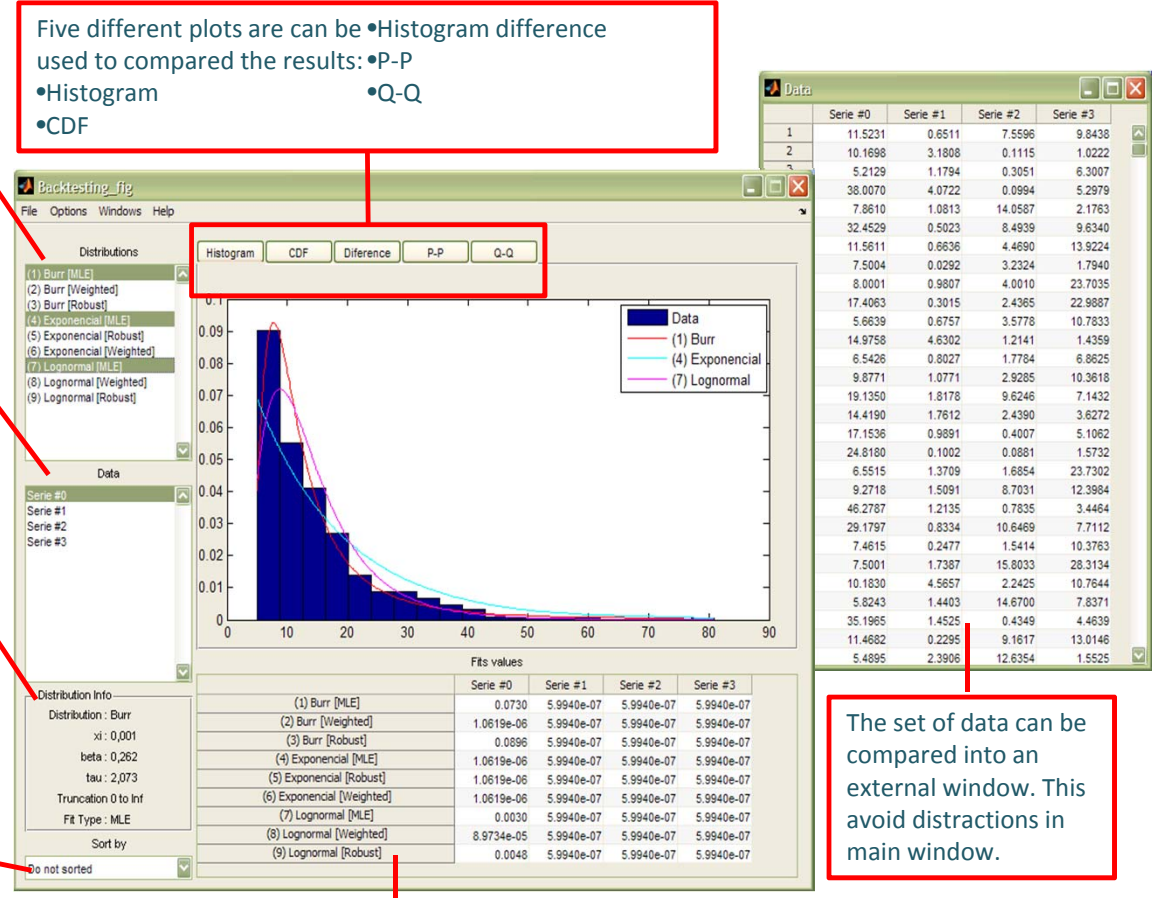
It is possible to compare different distributions fitted with alternative methods, parametric and empirical distributions, distributions from scenario analysis, etc.

The goodness of the fit of the fitted distributions can be analyzed with huge sets of data. Allowing a comparison of different series.

Information about the selected distribution:
 •Name
 •Parameters
 •Fit values
 •Fit type

It is possible to sort the distributions by:
 •Name
 •Anderson-Darling test
 •Kolmogorov-Smirnov test

Five different plots can be used to compare the results:
 •Histogram
 •CDF
 •Difference
 •P-P
 •Q-Q



The set of data can be compared into an external window. This avoid distractions in main window.

The goodness of the fit test can be observed in the bottom table.

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Use Test: Insurance Evaluation

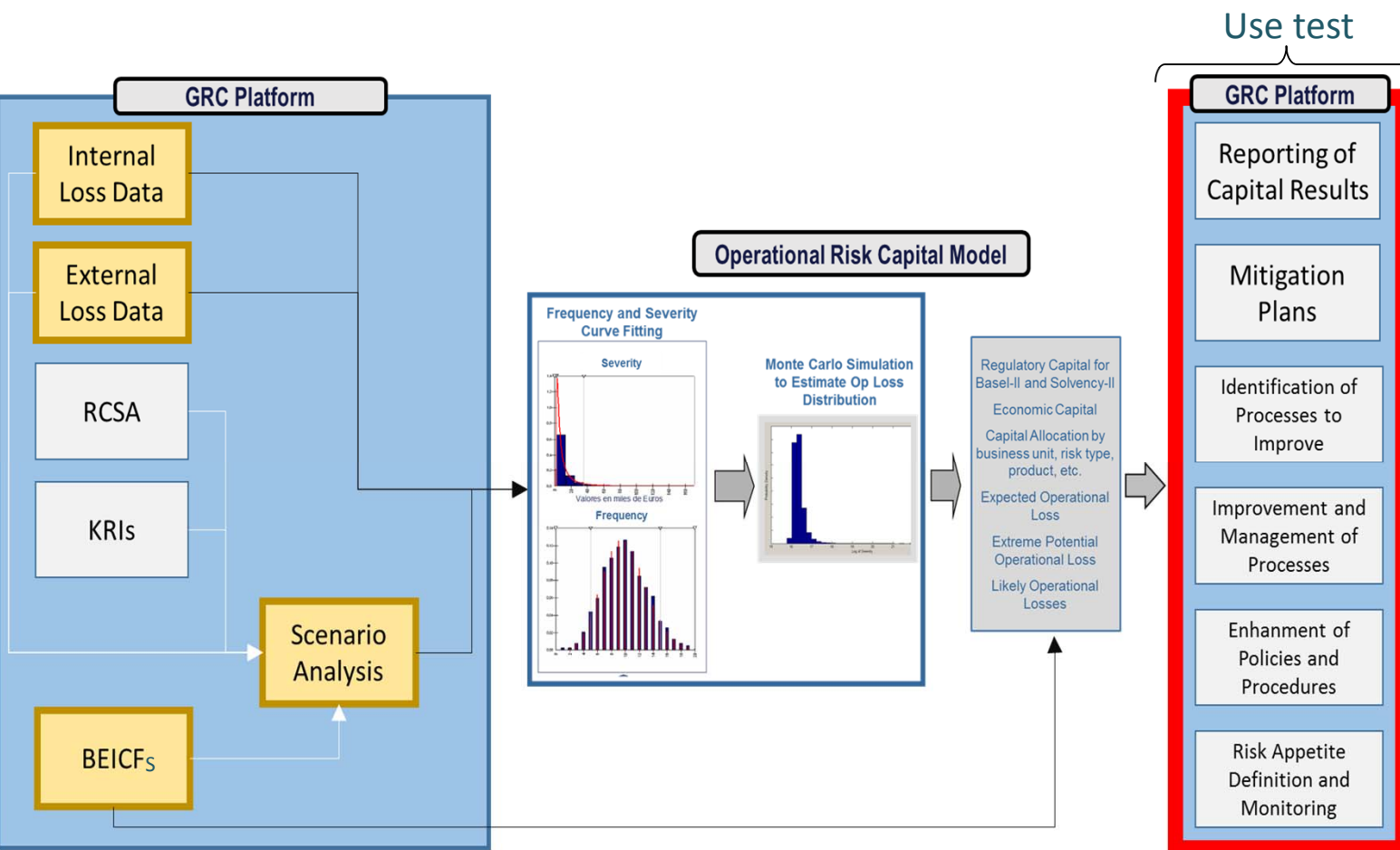
An AMA system adds fundamental value when integrated into the daily management and decision taking process of the institution. It should never be used solely for regulatory compliance, neither its outputs be perceived or treated as an abstract academic exercise.

“Banks use various approaches in an attempt to clearly articulate and demonstrate the integrated use of their ORMF. This is especially the case with the use of the ORMS within their day-to-day decision-making practices”.

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“The purpose and use of an AMA should not be solely for regulatory compliance purposes”

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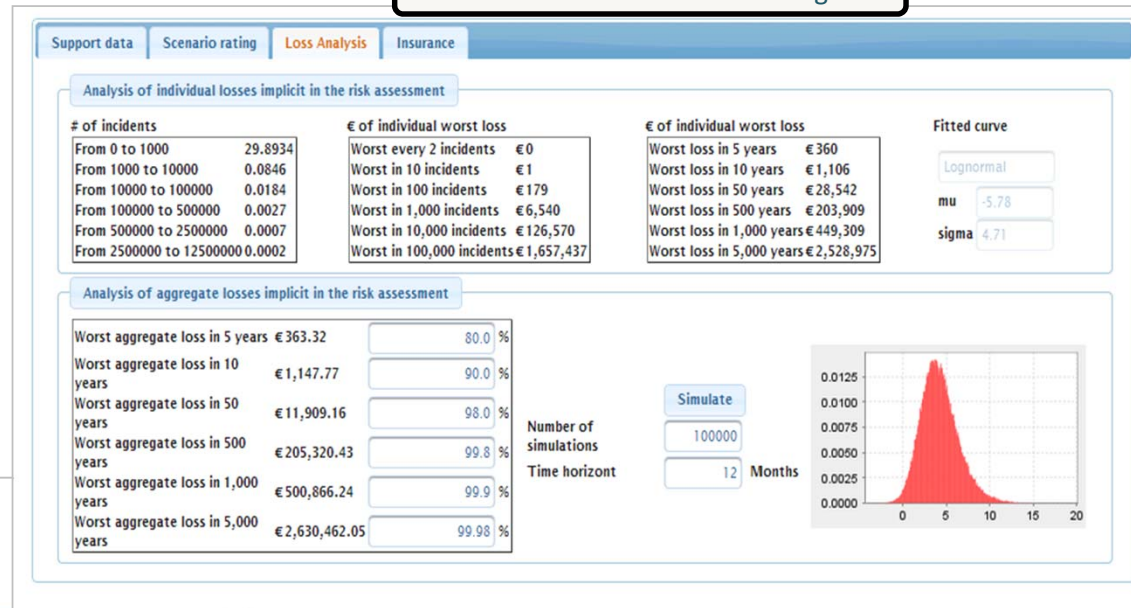
Use Test: Insurance Evaluation

AMA model used in the evaluation on the risk mitigation adequateness of insurance programs

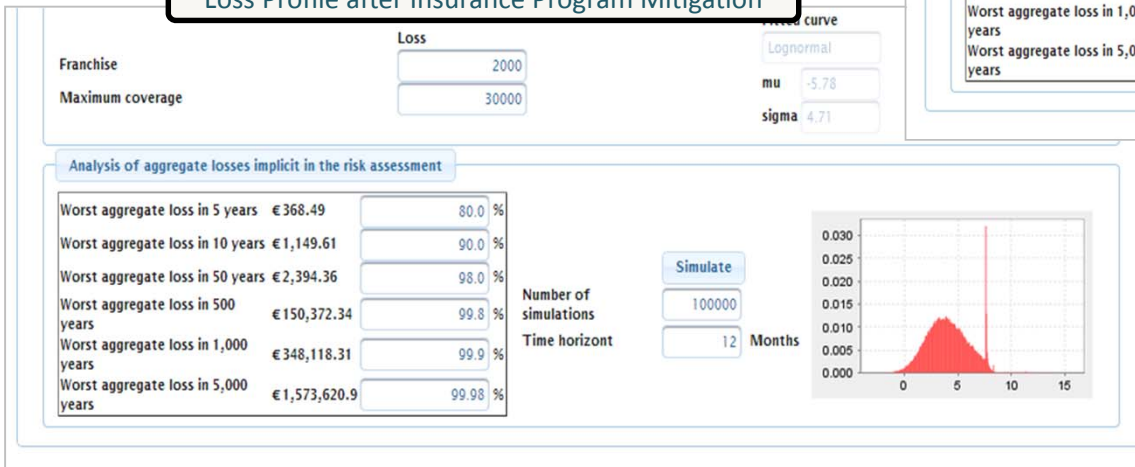
“the bank’s internal operational risk measurement system should be closely integrated into the day-to-day risk management processes of the bank”

Basel Committee on Banking Supervision

Loss Profile before Insurance Program



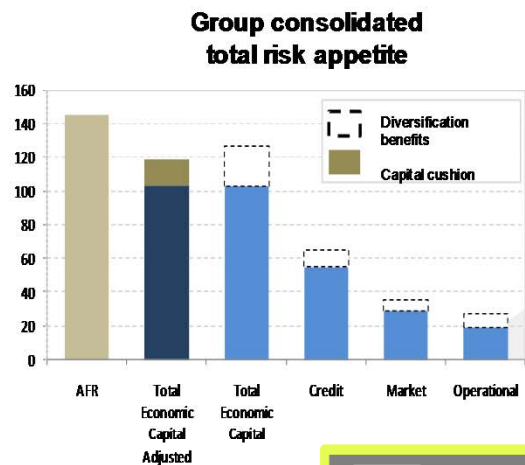
Loss Profile after Insurance Program Mitigation



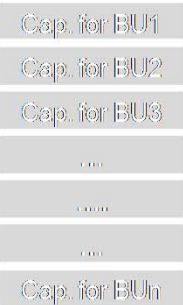
Governance

Use Test: Risk Appetite Determination and Monitoring

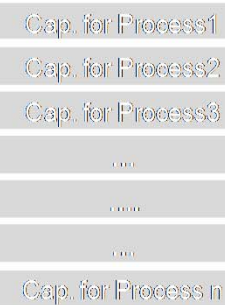
Using functionalities to model RCSA, AMA operational risk capital can be allocated down to RCSA granularity and risk appetite cascaded down and monitored to a much more granular level.



ORA allocated to BUs

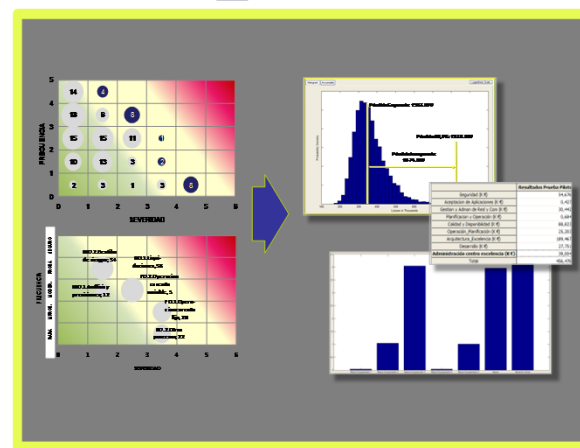
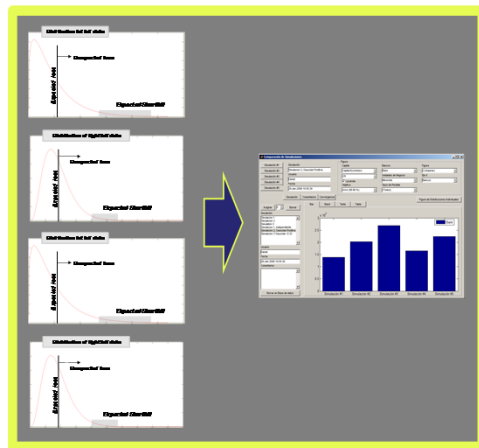


ORA allocated to RCSA granularity



“A bank’s board of directors should approve and review a clear statement of operational risk appetite and tolerance”.

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Governance

Use Test: Business Case for Investments in Risk Mitigation

AMA model used in the evaluation of the economic business case of different mitigation investments

Investment option with the highest absolute Net Value Added, although it requires a high investment

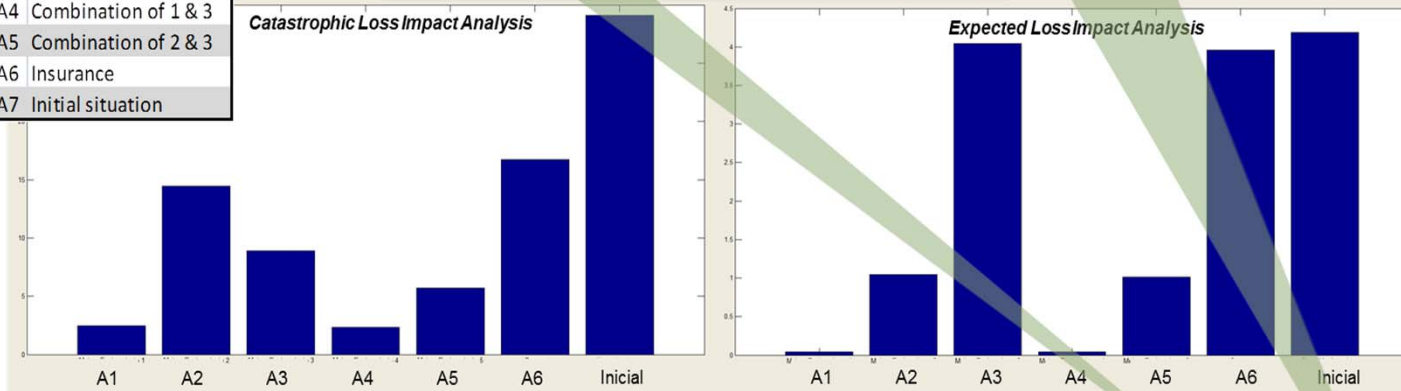
Although it does not provide a high absolute Net Present Value, its % return on investment is very attractive, given the low investment requirements

- A1 Complete rebump
- A2 Partial improvement
- A3 Loss limitation
- A4 Combination of 1 & 3
- A5 Combination of 2 & 3
- A6 Insurance
- A7 Initial situation

Monte Carlo Simulation Results from Modeling Losses and Investment Impacts in OpRisk

Catastrophic Loss Impact Analysis

Expected Loss Impact Analysis



Net Value Added Analysis by Investment Option (in € 000,000)

	Catastrophic Loss	Capital Cost	Expected Loss	Annual Saving	Total Saving	Capex	NVA	NVA/Capex
A1 Complete rebump	2,205	0,2646	0,04	6,84	28,06	12	16,06	134%
A2 Partial improvement	11,453	1,37436	1,033	4,74	19,44	5	14,44	289%
A3 Loss limitation	8,97	1,0764	4,054	2,02	8,27	2	6,27	314%
A4 Combination of 1 & 3	2,647	0,31764	0,041	6,79	27,84	14	13,84	99%
A5 Combination of 2 & 3	5,922	0,71064	1,015	5,42	22,23	7	15,23	218%
A6 Insurance	19,245	2,3094	3,944	0,89	3,67	3,3	0,39	12%
A7 Initial situation	24,721	2,96652	4,181	0	0	0		

“Embeddedness” is defined as the level to which ORMF processes and practices have been embedded across a bank’s organisational levels. The supervisory review of embeddedness entails an assessment of managerial judgment and decision making and is broader than a “point-in-time” assessment “.

Basel Committee on Banking Supervision

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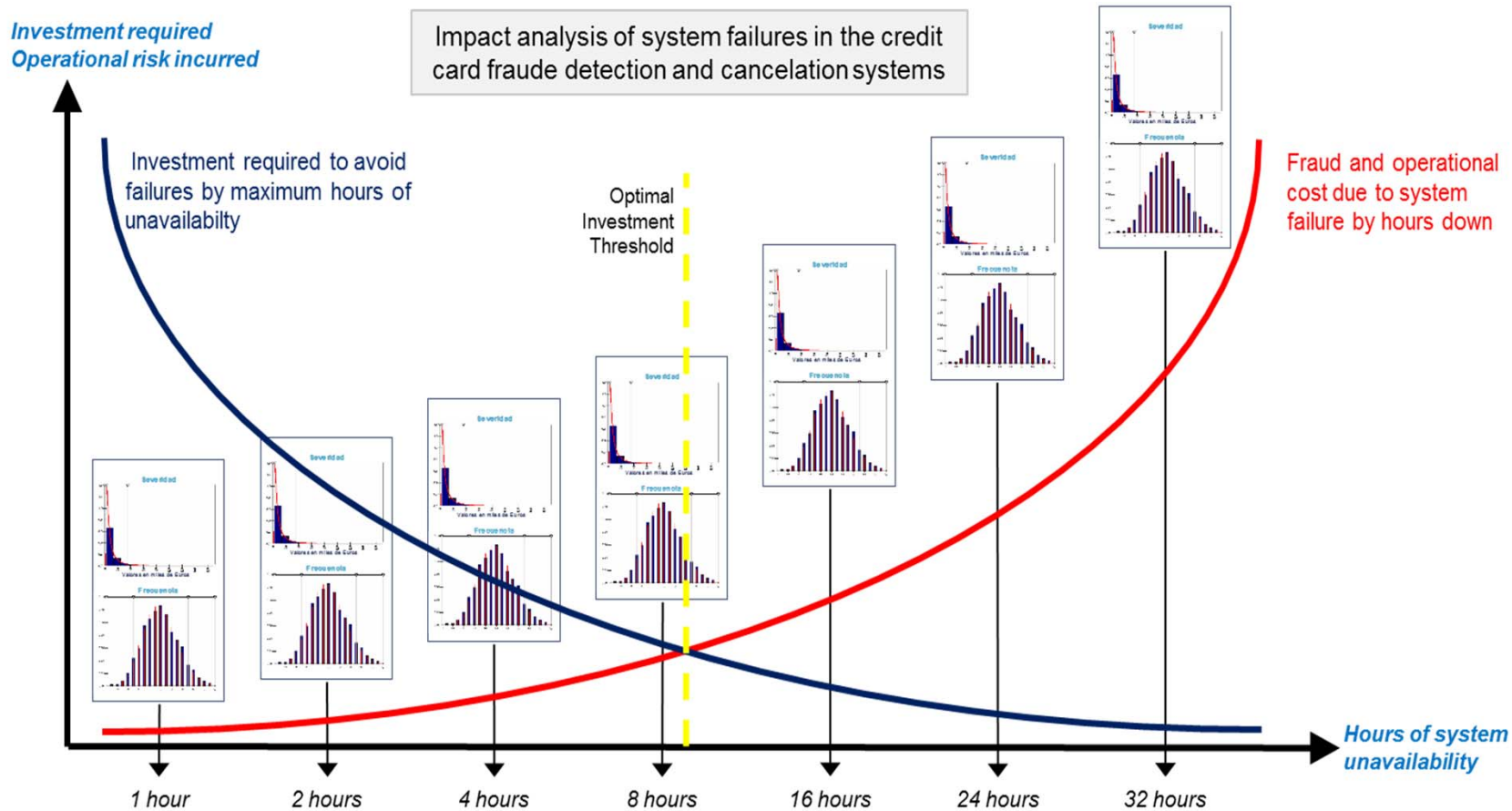
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Use Test: Business Case for Investments in Risk Mitigation

AMA model used in the evaluation of adequate investment for availability of fraud detection systems



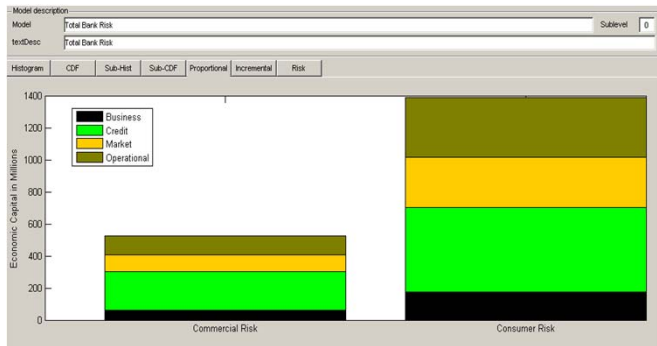
Analyzing the marginal costs for increasing the availability of fraud detection systems as compared to the fraud costs during the systems failure, helps to identify optimal investment

Governance

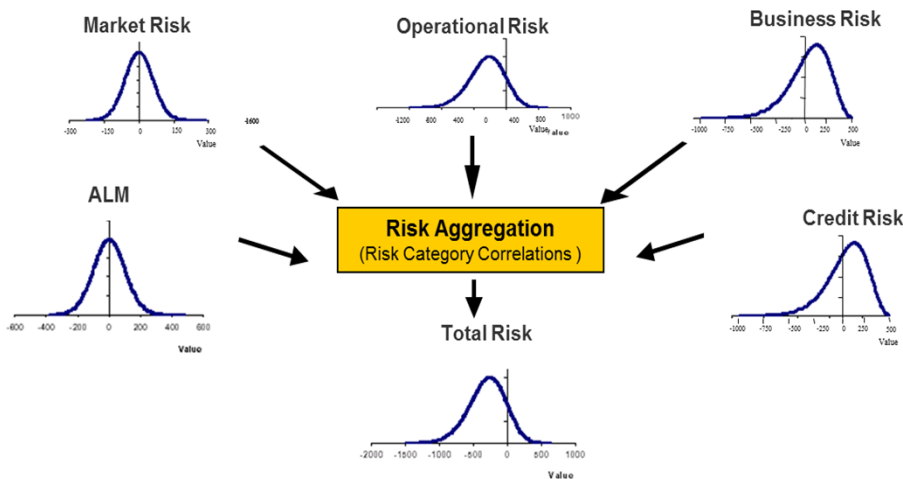
Use Test: Integration into performance measurement

Integration of AMA model results into the institution's economic capital and performance measurement processes (RAROC, EVA, etc.)

Diversified Capital Allocation by Risk Type and Business Unit



Operational risk capital results can be aggregated together with the other capital estimates from other risk categories, and incorporated into the performance evaluation models (RAROC, EVA, etc.)



	Commercial Risk	Consumer Risk
Business	77328071.4267	245176122.1163
Credit	275226472.0582	575042235.9705
Market	150862302.3882	500040240.3159
Operational	23606175.2392	69909269.1122

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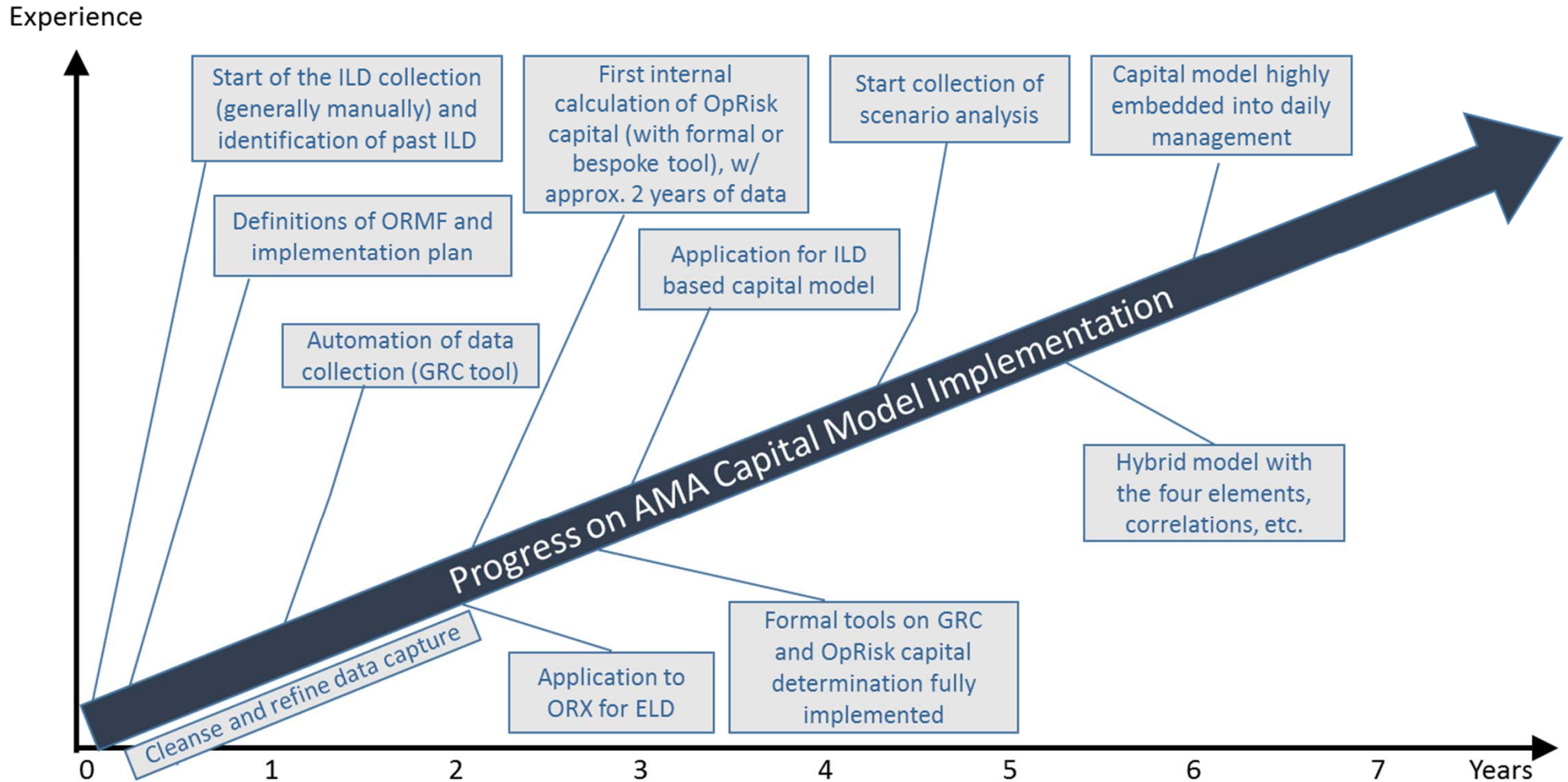
Path to AMA

AMA implementation trends

Current Trends

Path to AMA

Although there are different speeds for developing an OpRisk capital model, there is a typical progression when implementing a full AMA capital model. SKITES can support you during the whole process until your AMA model is fully developed and integrated into the daily management of the institution, including the regulatory approval.



Current Trends

AMA Implementation Trends

Basel Committee		
Supervisory Guidelines for AMA		OpRisk Capital Modeling Current Trends
Governance	Verification	Institutions implementing more formal tools for capital modeling, to allow audit trail, replicability of results, automatic documentation of assumptions, user control, reporting, integrity of data flows, etc. Early adopters of AMA models developed bespoke models and are currently migrating to more formal software.
	Validation	Institutions are developing methodologies and tools to implement backtesting capabilities
	Use test	Depending on the experience, institutions start with a pure capital reporting, which is later embedded into the RAROC model. As institutions grow on experience, the use of the OpRisk model gets into insurance evaluation, identification of BU and processes requiring additional controls and improvements, justification of necessary investments, etc.
Data	Managed at the GRC platform	Agreement of operational loss definitions partly thanks to ORX standards. Efforts focus on completeness of data capture and consistency with accounting.
Modeling	Granularity	Agreement of ORC, while BUs are defined based on bank's idiosyncrasies although a matching is done to ORX BU classification. Capital allocation methodologies are evolving towards tail risk driven methods.
	Distribution assumptions	Most institutions model based on LogNormal, Gamma, Pareto, Weibul and GEV. PoT and EVT are commonly used for threshold and tail type determination. Split between body and tail is very common and, non parametric distributions may be used for the body and fat tail distribution for tail. Institutions are doing efforts to develop capital stability functionalities and the evaluation of the realism of the capital results without the need to launch a lengthy Monte Carlo Strong emphasis is put into analyzing and modeling extreme events GoF dominated by AD and KS P-Values, combined with graphical analysis such as PP and QQ plots
	Joint distribution	Monte Carlo is the most common way to determine the total loss distribution. The single loss approximation is used for quickly estimating capital while analyzing data and modeling
	Correlation and dependence	Most commonly, the Gaussian copula is used for modeling correlations. However, many regulators encourage the use of t-Student copula for a more precise tail risk modeling. Correlations are many times determined by Multivariant MLE, particularly when t-Student copula is used
	The use of the 4 elements	Institutions generally start with a ILD based model and evolve towards a hybrid model incorporating SBA, ELD, etc. ELD is many times used to inform SBA. BEICF are most commonly embedded into the SBA.