GRC ANALYTICS

EXHAUSTIVE COVERABLE, USER FRIENDLY AND FLEXIBLE OFFERING

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APRIL 2020

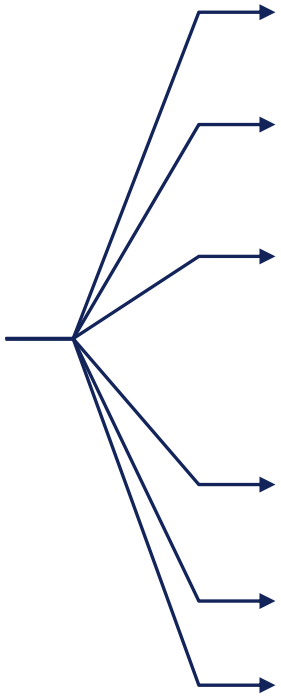
THE ANALYTICS BOUTIQUE

Analytics made friendly

A TRUE NORTH PARTNERS company

The Analytics Boutique (TAB) is a risk analytics software company that builds user friendly analytics solutions to uplift the risk capability of your institution

We believe that analytics teams, rather than designing and developing code, should be focused on value added tasks, being assisted by user friendly tools with full model governance, integrity of data flows between analytical processes and mechanised report generation



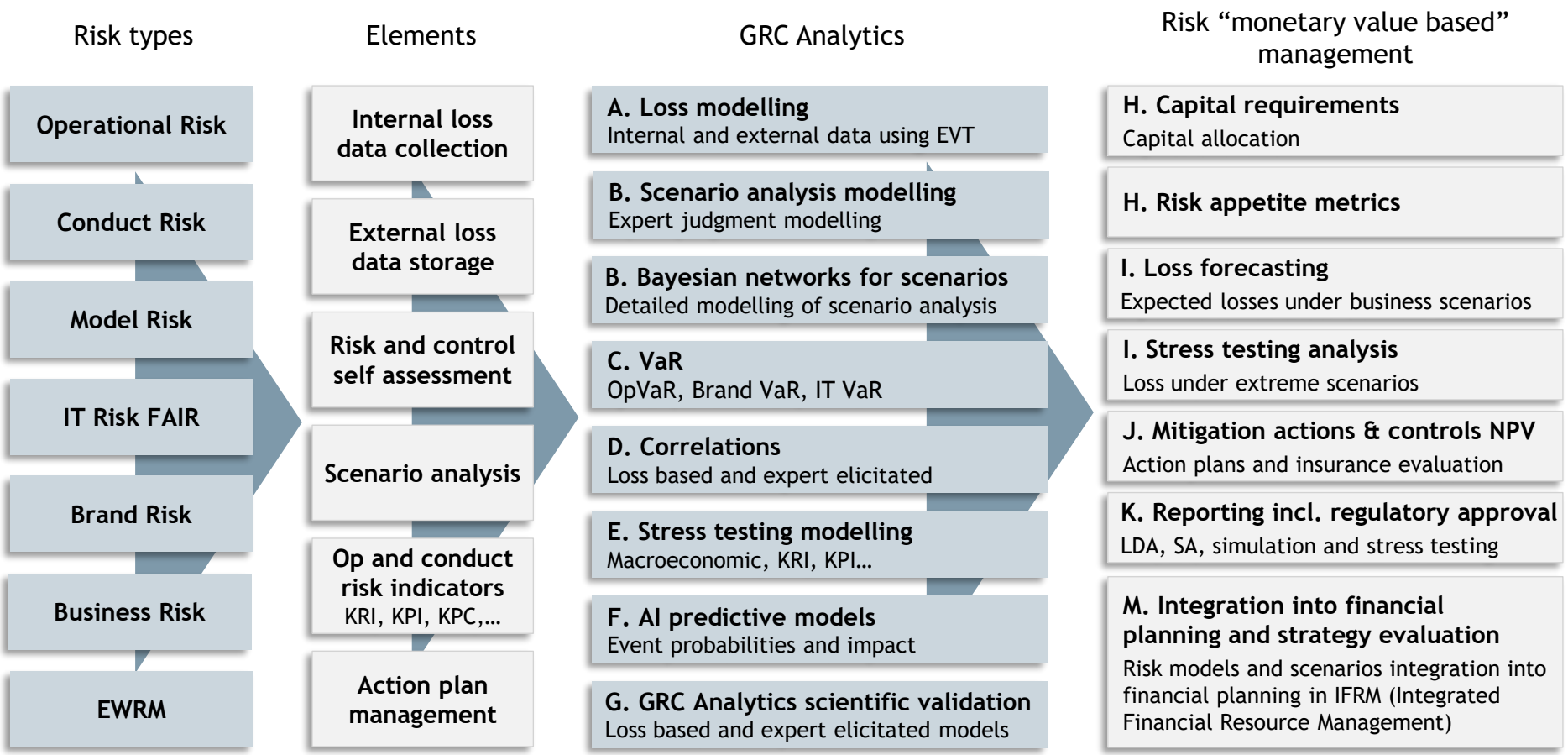
- Enable user friendly and transparent analytical processes
- Bring in industry standards and best practices in analytics
- Provide full model governance with audit trail, user control and thorough reporting features
- Minimise model errors as a result of the elimination of manual processes
- Reduce dependence on coding experts due to automation of analytic processes and data flow
- Deliver full model validation features
- Our Analytics delivers the money value of risk allowing a “monetary value based” management

We help organisations move from data to action

Award winning TAB's Operational and Conduct Risk offering represents a breakthrough addressing most burning issues in judgment based risk assessments

Cognitive biases mitigation	▪ Structured Scenario Analysis is designed to mitigation multiple biases: need for closure, herding or group thinking, confirmation biases, anchoring biases, authority biases and other
risk measurement & mitigation jointly	▪ In Structured Scenario Analysis, risk mitigation is evaluated together with risk evaluation, using a scientific method based on calculating the money value of risk
Money value of risk	▪ By on-the-fly Monte Carlo simulation, it calculates the cost of assuming risks and compares it with the savings of hedging/controlling such risk providing the NPV of mitigation actions
Scientific validation of expert judgment	▪ Structured Scenario Analysis implements performance based expert judgment which allows to validate responding experts based on limited available information
Efficiency features and for engaging your organization	▪ It enables a workflow, email sending system, expert responding progress page, reminders, answers automated aggregation, extensive reporting, and more
Correlation approach	▪ Structured Scenario Analysis provides a solid cross-scenario correlation approach based on expert judgment ▪ Correlations are very transparent, intuitive and easy to justify
Robust and stable capital calculation	▪ Structured Scenario Analysis integrates different sources of data (ILD, ED and BEICFs) to compute a more stable capital charge, adding information of the distribution tails, reducing the volatility of capital estimates
Analytics available to 1st line of defence	▪ Structured Scenario Analysis provides, to the first line of defence, the cost of risk, saving from mitigation and NPV of action plans required investing, encapsulating all modelling complexities thanks to AI algorithms
Strong governance	▪ User control, audit trail, roles and activities differentiated by user and other
Fully flexible	▪ Flexible forms, user defined number of loss collection processes, indicators, configurable workflow, etc.

The Analytics Boutique's covers the widest GRC Analytics spectrum



We are well recognised in the GRC industry for our award wining offerings in the op risk management, measurement and stress testing space

2016/17 industry award recognition with 5 awards…and 5 awards in 2018/19

OperationalRisk Awards 2016 – Best overall product of the year
Risk Technology Awards 2018 Winner – The Analytics Boutique – Op risk modelling vendor of the year

OperationalRisk Awards 2016 – Best risk analytics tool
Risk Technology Awards 2018 Winner – The Analytics Boutique – Op risk scenarios product of the year

OperationalRisk Awards 2016 – Best stress testing product
Risk Technology Awards 2019 Winner – The Analytics Boutique – Op risk modelling vendor of the year

By Risk.Net (Risk Magazine)

InsuranceERM Awards 2016/17 – Best analytics solution
InsuranceERM Awards 2018/19 – Best analytics solution
InsuranceERM Awards 2016/17 – Best stress scenario software
InsuranceERM Awards 2018/19 – Best operational risk solution

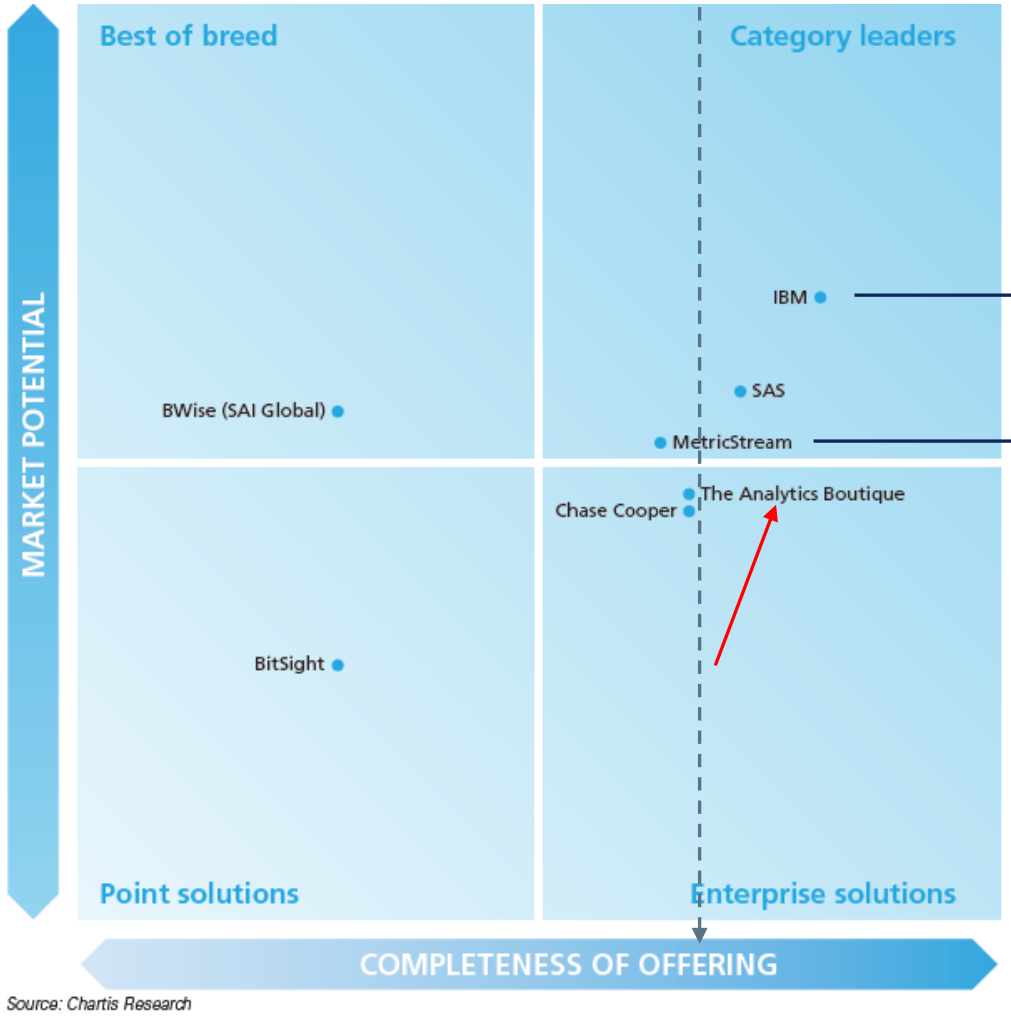
By InsuranceERM

Thanks to our capital modelling technology we are the leader of the Enterprise solution in the GRC Analytics (broad) category

Chartis
Independent. Insightful. Actionable.

Enterprise GRC Solutions, 2019
Market Update and Vendor Landscape

Chartis RiskTech Quadrant® for GRC analytics solutions, 2019



Source: Chartis Research

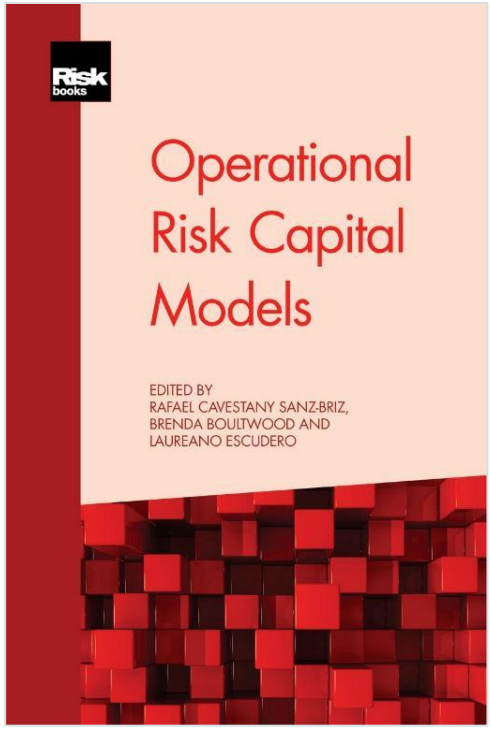
We are the capital modelling and scenario analysis provider of category leaders

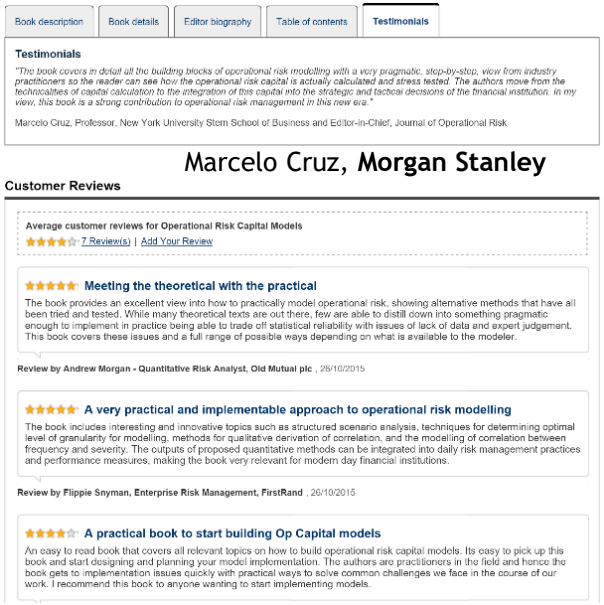
We are thought leaders in the risk industry and have made significant contributions to the advancement of the GRC Analytics industry

"I found the quantitative methods presented in "Operational Risk Capital Models" to be not only rigorous, but also understandable and actually useable and useful, which can be said of shockingly few books treating operational risk. Amidst a wasteland of operational risk management pie charts and unactionable and subjective heat maps, books like this are an oasis of practical, applied solutions for capital estimation and stress testing. If your objective is to directly and measurably mitigate and manage operational risk using scientifically defensible, objective methodology, as opposed to red-amber-green traffic 'analyses,' the methods herein are the kind you need."

J.D. Opdyke, **GE Capital**

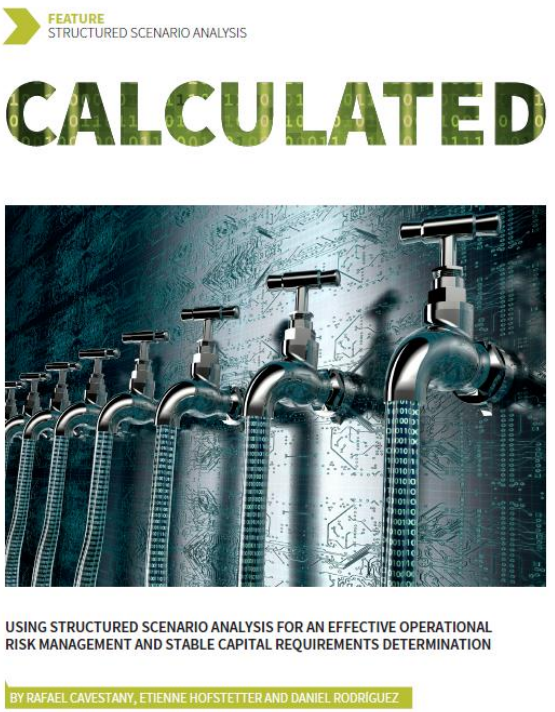
RiskBooks, Incisive Media



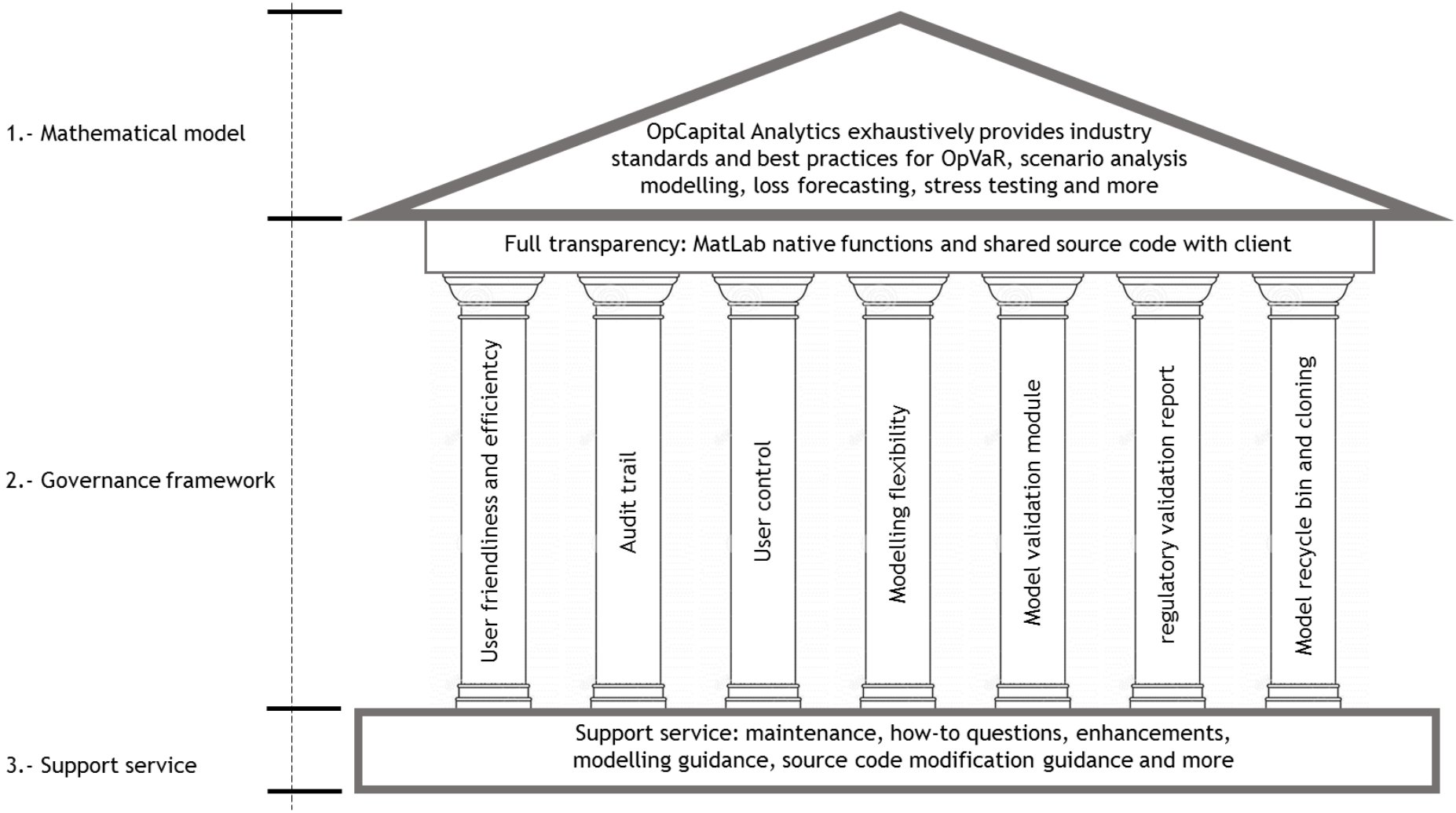


Marcelo Cruz, **Morgan Stanley**

The Actuary Magazine, Society of Actuaries



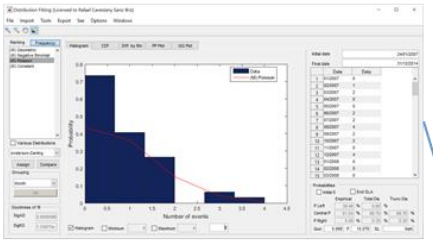
TAB's GRC Analytics contains an extensive mathematical model supported by a strong governance framework and TAB provides robust support service



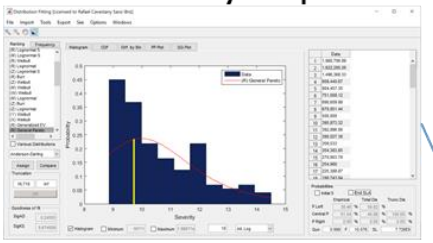
Our GRC Analytics has a model risk governance and validation features: auto-storing all modelling data, audit trail, one-click model replication, reg. reports…

Using our GRCs Analytics model risk governance module can be used for model validation and approval, review of all model assumptions, replication of the model, reporting of the full model, in an extremely efficient manner

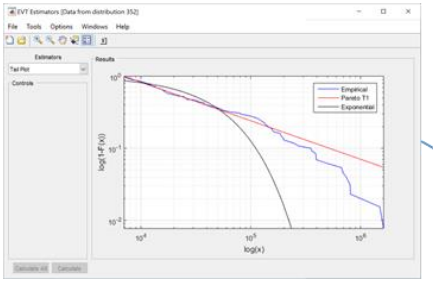
One-click frequency fit replication



One-click severity fit replication



One-click EVT replication

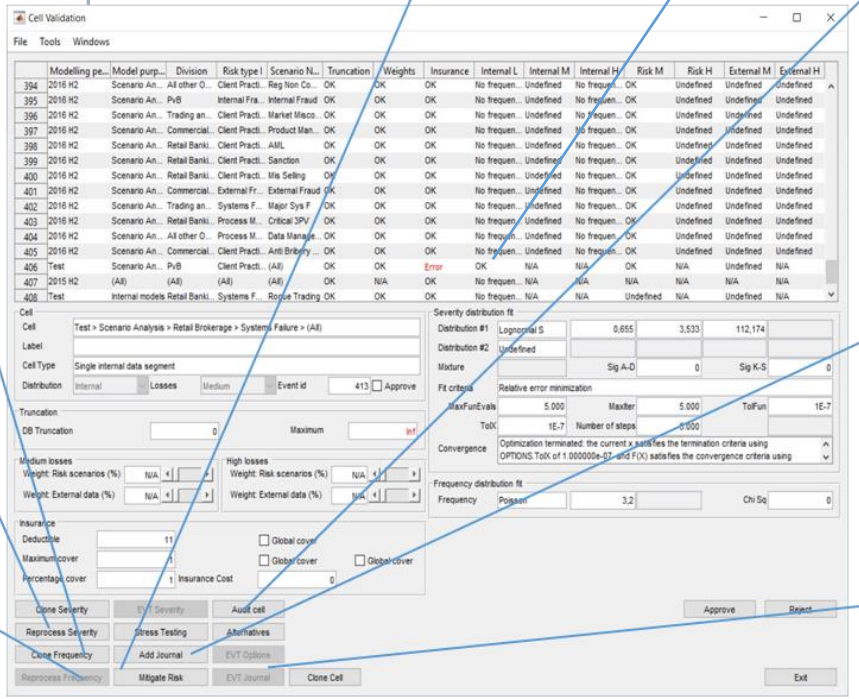


Model recycle bin
Model cloning
Model copying

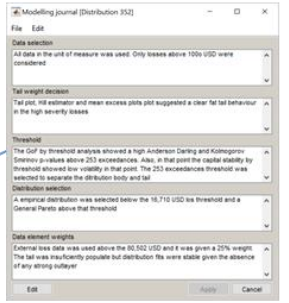
Risk mitigation conclusions

Regulatory approval reporting

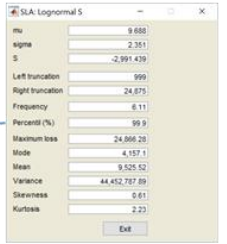
Audit trail



Modelling journal



Sensitivity analysis

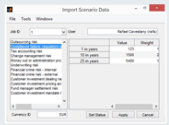


Our GRC Analytics solution provides integrated specific modules for each of the critical blocks for the risk capital, stress testing and AI models

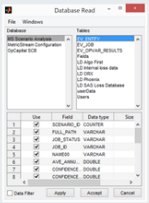
Including Basel Capital's AMA & Pilar 2

Op data import

Import scenarios



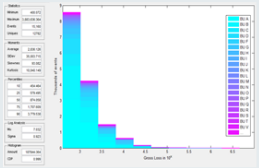
Import internal and external loss data



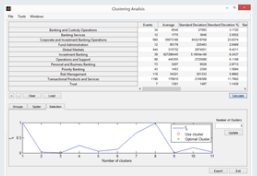
Import KRI, KPI...

UoM definition

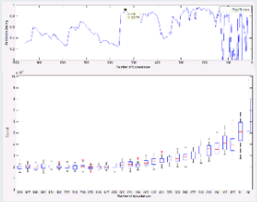
Exploratory analysis and loss data selection



Optimal granularity

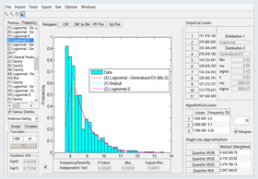


Extreme Value Theory Analysis

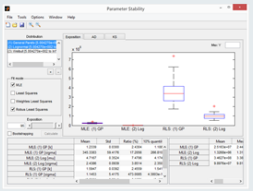


Risk capital modelling

Loss data modelling

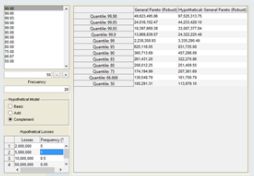


Capital instability analysis

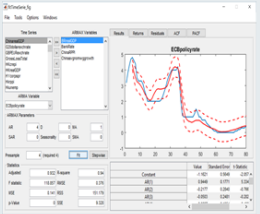


Scenario analysis modelling

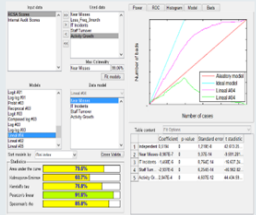
What-if analysis



Stress testing



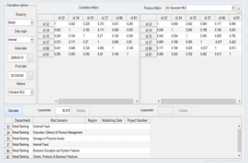
AI prediction models



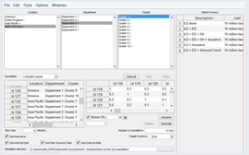
OpVaR and capital

Hybrid model construction

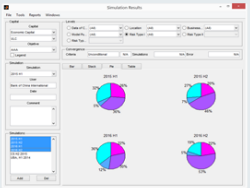
Correlation analysis



Monte Carlo simulation

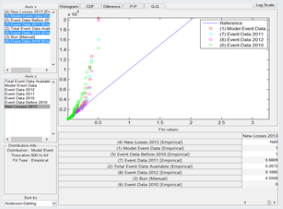


Capital estimates analysis

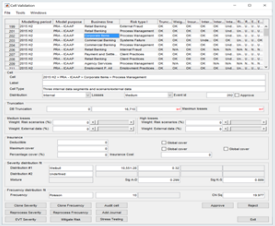


Model validation

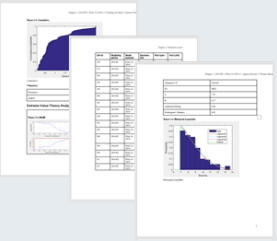
Backtesting



Modelling archive and results replication



Validation reports



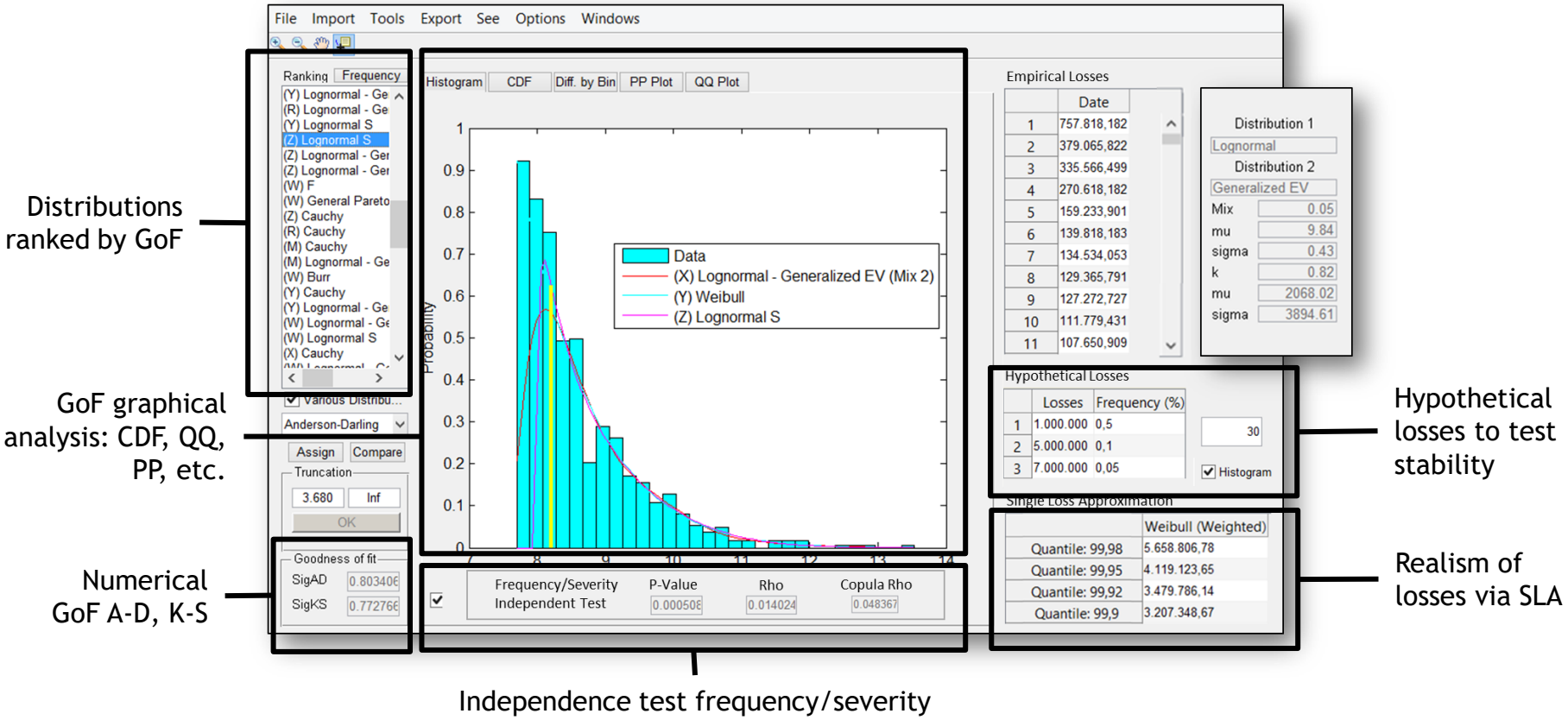
Audit trail, user control, integrated data flows, workflow management, reporting and model archive and replication

ANNEX A: GRC Analytics

Internal and external loss data modelling can be performed in great detailed and precision

Our GRC Analytics provides multiple features for a robust modelling of loss data that includes distribution fitting, Extreme Value Analysis, graphical and numerical goodness of fit analysis, stress testing, instability analysis and more.

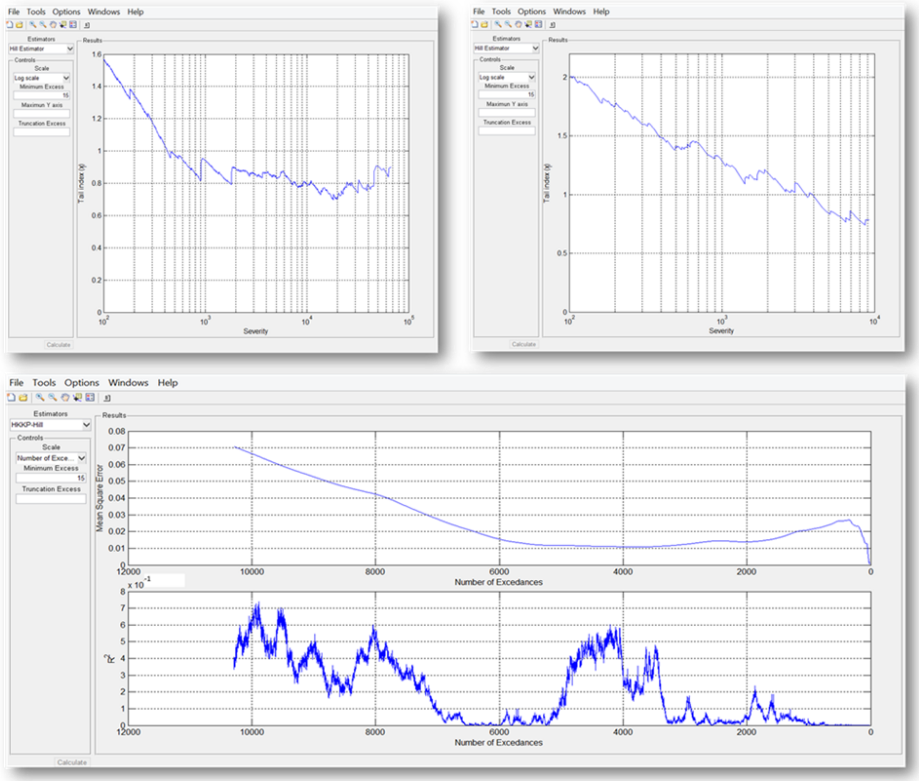
Distribution fitting module (severity and frequency)



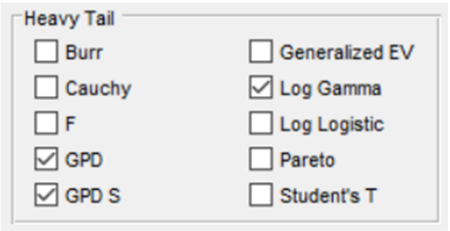
For loss modelling, TAB provides extensive functionalities permitting the precise determination of modelling thresholds and tail type

The system provides up to 8 methods to estimate Extreme Value Theory and determine tail weight and identify an optimal threshold permitting to separate the distribution in tail and body

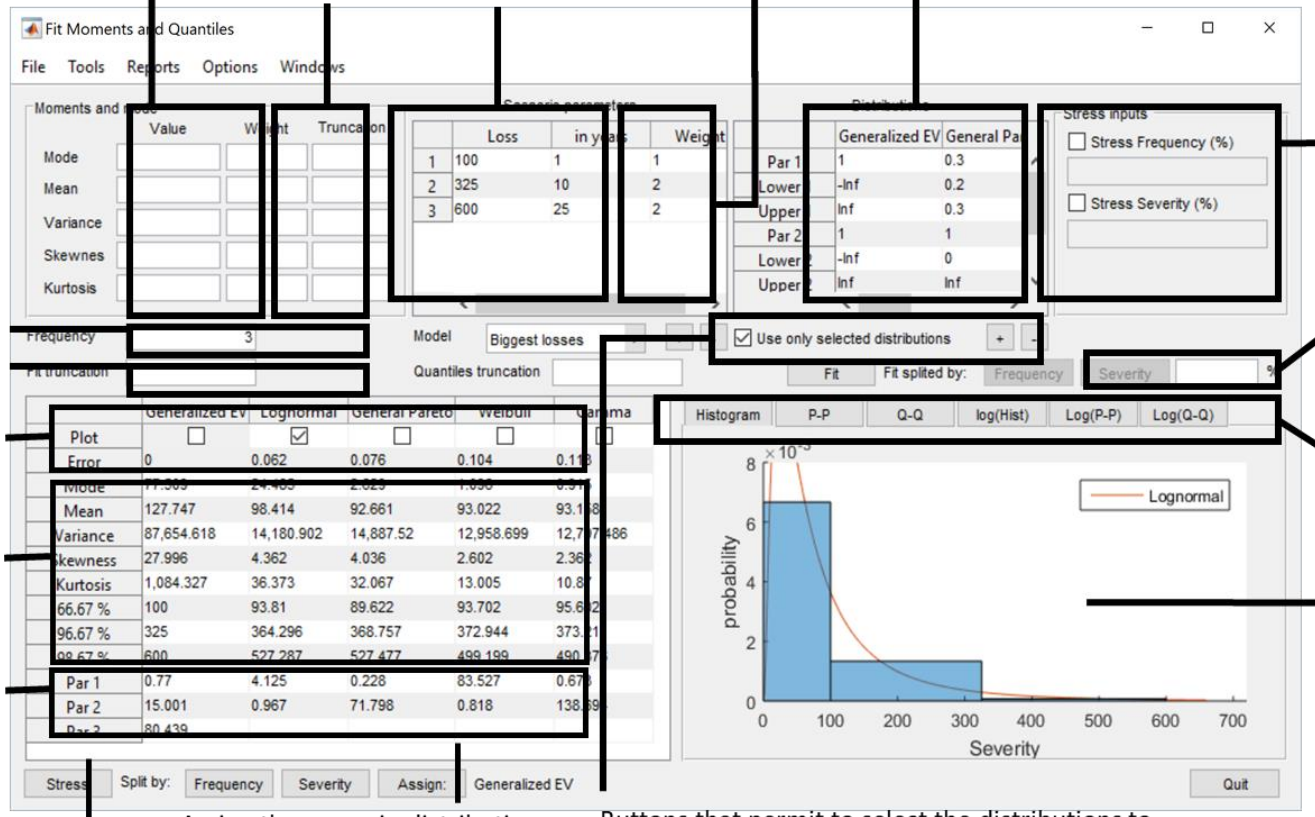
EVT methods for determining tail weight and modelling threshold
Lognormal Fit Analysis Fits a LogNormal distribution and plots Mu and Sigma.
Stability Parameter Fits Pareto distribution and plots tail parameter.
Tail Plot Plots Log (Severity) versus Log(1-F(Severity)).
Mean Excess Plot Plots the mean excess of each sample
Hill Estimator Plots tail parameter calculated analytically
Hill Estimator Extension Fits a horizontal line to the Hill Estimator plot to identify the point most similar to a constant tail parameter and, therefore, fat tail.
Capital Stability by Threshold Plot Randomly resamples an x% of the Sub-sample y times. Fits the selected distribution to random subsample with the selected fitting method and plots capital charge calculated using analytical methods.
GoF by Threshold Plot Fits selected distribution and plots P-Value of AD and KS.



Fat tail distributions available for EVT



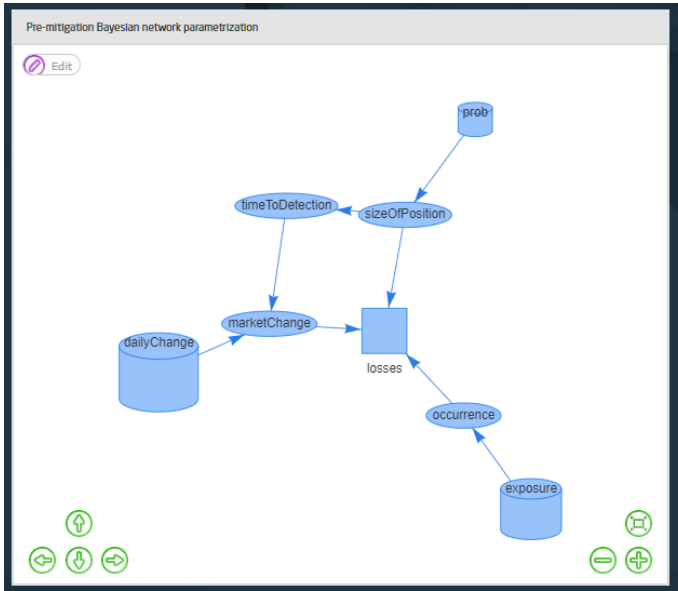
TAB provides extensive options for the modelling of scenario analysis and corresponding mitigation and any other expert elicitated risk evaluation



SSA permits to model scenarios using a variety of methods including Bayesian networks for those scenarios most sensitive to current exposures or in which detailed analysis is needed for a precise estimation of losses or mitigation impact

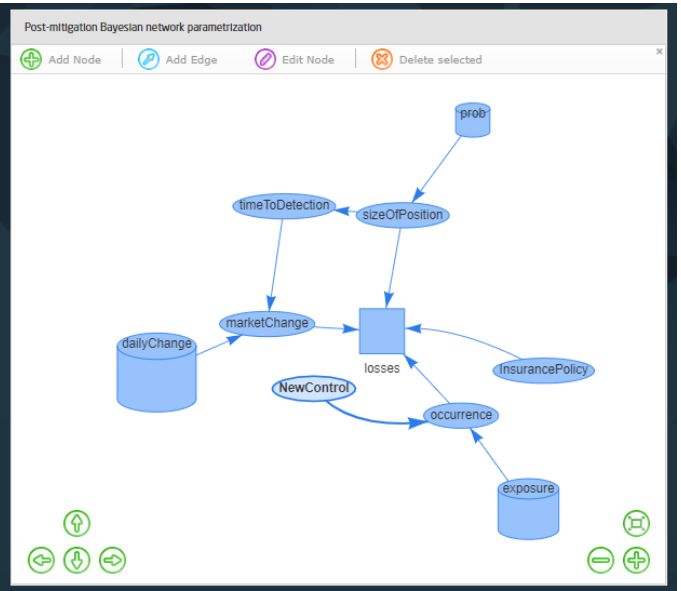
A complete and efficient modelling of scenario analysis requires the combination of modelling methods. Bayesian networks may be used in exposure sensitive scenarios or requiring a precise loss estimation or mitigation NPV. Less critical scenarios might be modelled using direct and less resource intensive methods such as direct estimation of losses (worst loss in 10 years…)

Pre-mitigation analysis



Pre-mitigation loss distribution of aggregated answers		
Expected loss :	70,951.00	
Percentile	Stand alone	Diversified
1 in 20 years (95.00 %)	0.00	0.00
1 in 100 years (99.00 %)	2,425,348.02	1,940,278.42
1 in 200 years (99.50 %)	3,748,207.40	2,998,565.92
1 in 1,000 years (99.90 %)	8,316,167.10	6,652,933.68
1 in 2,000 years (99.95 %)	8,829,727.69	7,063,782.15

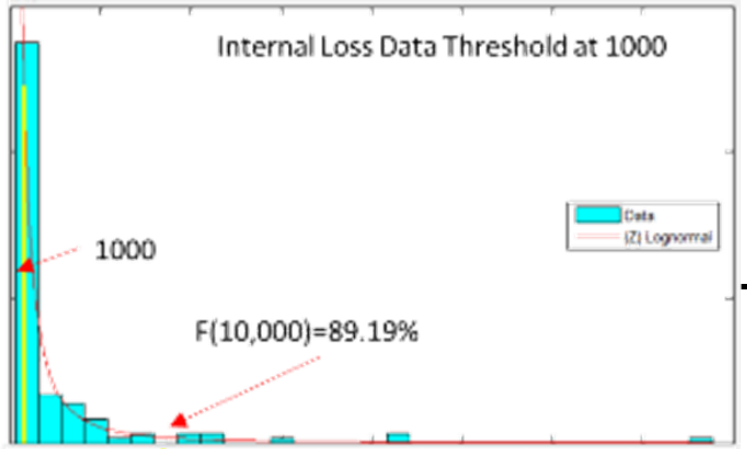
Post-mitigation analysis

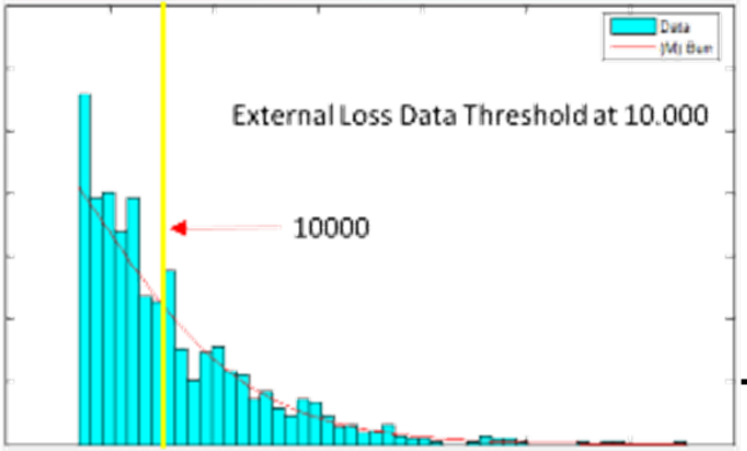


Post-mitigation loss distribution of aggregated answers		
Expected loss :	23,766.65	
Percentile	Stand alone	Diversified
1 in 20 years (95.00 %)	0.00	0.00
1 in 100 years (99.00 %)	939,564.03	751,651.22
1 in 200 years (99.50 %)	1,547,980.43	1,238,384.35
1 in 1,000 years (99.90 %)	3,369,497.52	2,695,598.01
1 in 2,000 years (99.95 %)	4,452,614.70	3,562,091.76

Internal & external loss data and scenario analysis create hybrid models incorporating all available information for risk measurement and management

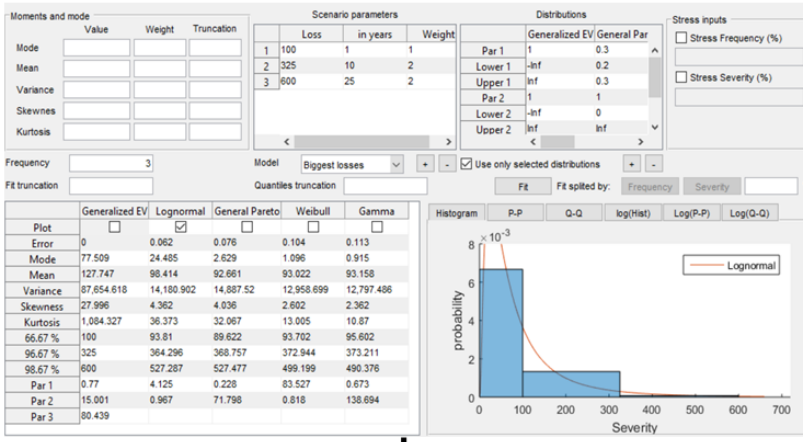
Internal loss data modelling





External loss data modelling

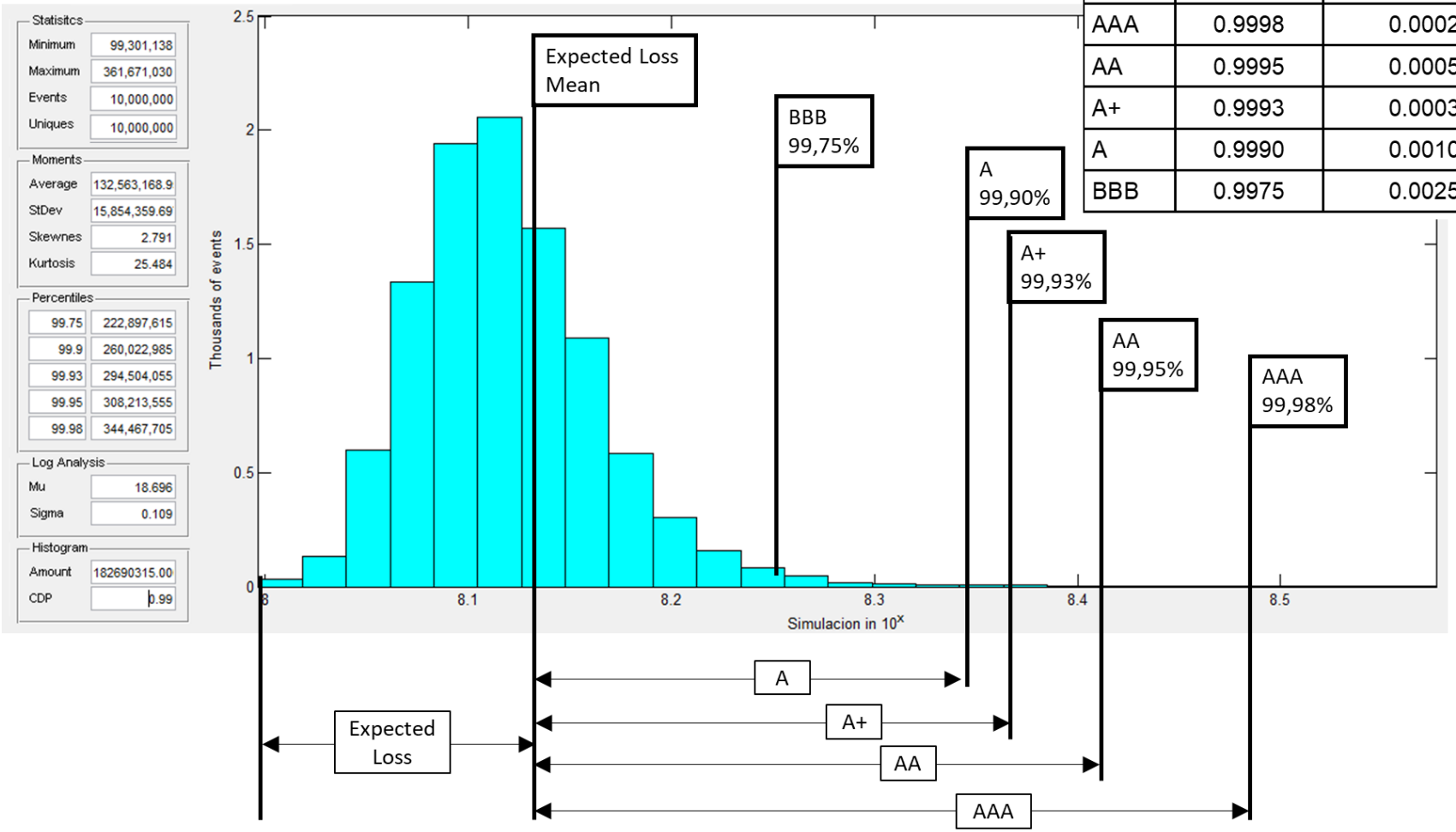
Scenario analysis modelling



Hybrid model

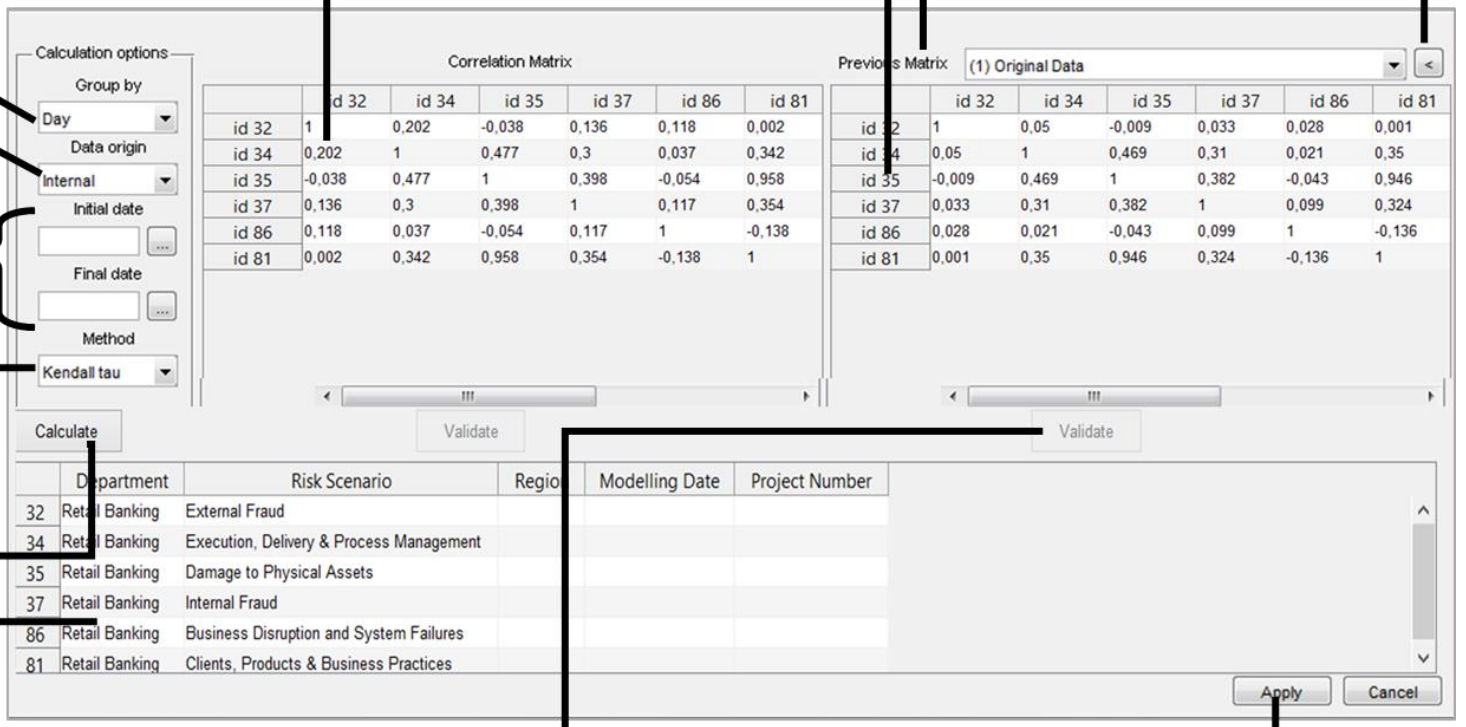
Our GRC Analytics includes VaR calculation under a user defined confidence levels and any other metrics: expected shortfall, unexpected loss and others

Target Rating	Confidence Interval	Annual Default Probability
AAA	0.9998	0.0002
AA	0.9995	0.0005
A+	0.9993	0.0003
A	0.9990	0.0010
BBB	0.9975	0.0025



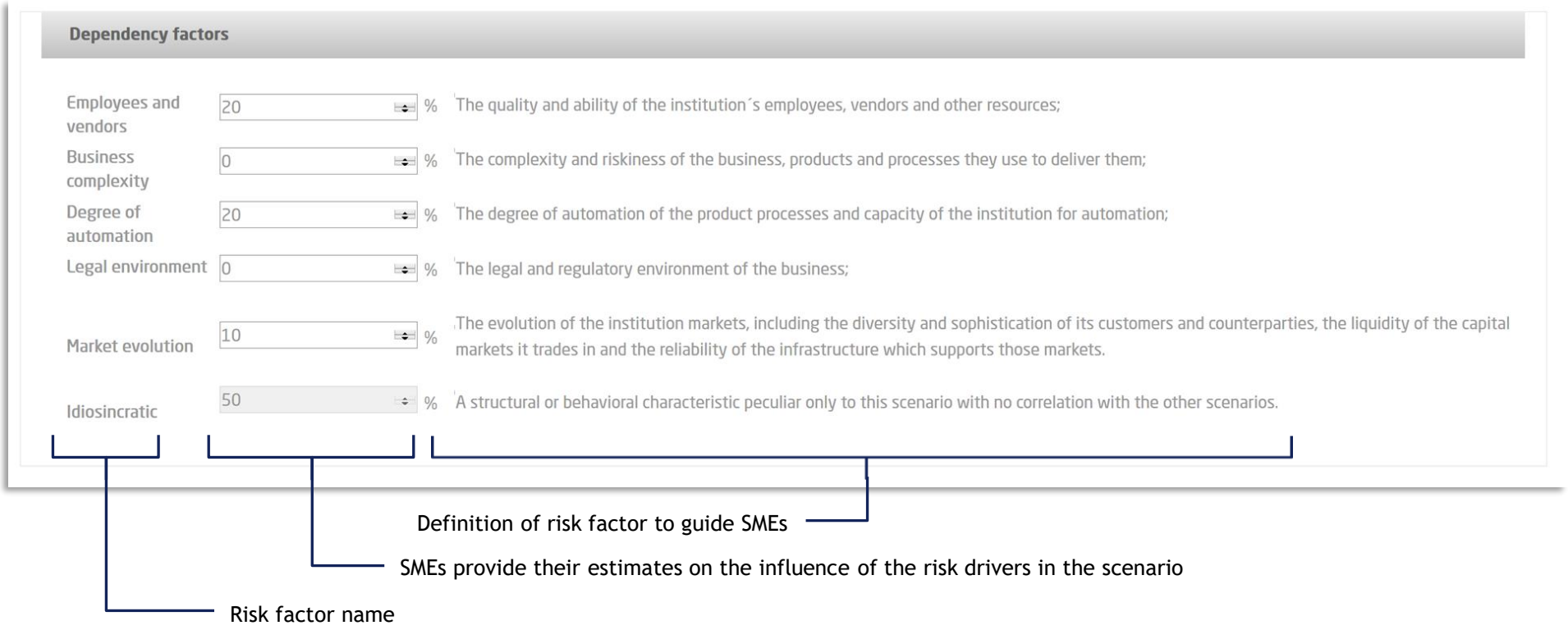
Our GRC Analytics are flexible and can be applied across other GRC Risk categories such as BrandRisk and obtain Brand VaR or IT Risk

TAB provides extensive functionalities for the determination of correlations based on loss data permitting easy comparison, selection and storage



When enough relevant loss data is not available for correlation calculation, our GRC Analytics permits the determination of correlations through expert elicitation

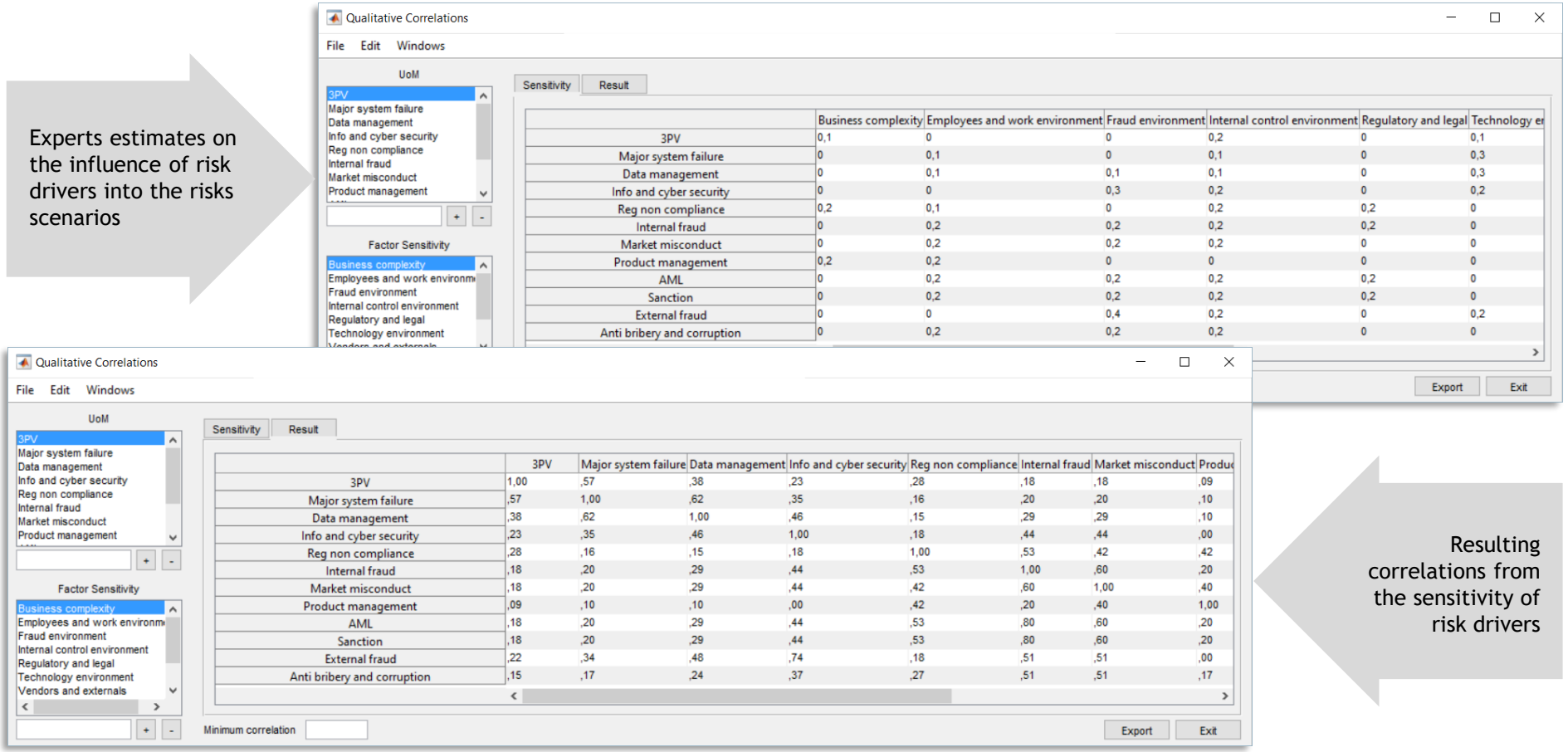
- Experts provide their estimate on the influence of the different environment factors that impact crystallisation of risks. These estimates are later weighted by the seed questions performance score obtained by each expert
- The final risk scenarios correlation matrix is calculated with the correlations across the environment factors and the weight of each factor in the risk scenario



TAB provides methods for determining risk dependencies using expert elicitation methods, being fully integrated into the tool`s calculations

Sensitivity to common environment factors is used to determine correlations. A high correlation can be tracked to sensitivities to the same environment factors. Independent scenarios derive from sensitivity to different environment factors

Experts estimates on the influence of risk drivers into the risks scenarios



	Business complexity	Employees and work environment	Fraud environment	Internal control environment	Regulatory and legal	Technology er
3PV	0,1	0	0	0,2	0	0,1
Major system failure	0	0,1	0	0,1	0	0,3
Data management	0	0,1	0,1	0,1	0	0,3
Info and cyber security	0	0	0,3	0,2	0	0,2
Reg non compliance	0,2	0,1	0	0,2	0,2	0
Internal fraud	0	0,2	0,2	0,2	0,2	0
Market misconduct	0	0,2	0,2	0,2	0	0
Product management	0,2	0,2	0	0	0	0
AML	0	0,2	0,2	0,2	0,2	0
Sanction	0	0,2	0,2	0,2	0,2	0
External fraud	0	0	0,4	0,2	0	0,2
Anti bribery and corruption	0	0,2	0,2	0,2	0	0

	3PV	Major system failure	Data management	Info and cyber security	Reg non compliance	Internal fraud	Market misconduct	Produc
3PV	1,00	,57	,38	,23	,28	,18	,18	,09
Major system failure	,57	1,00	,62	,35	,16	,20	,20	,10
Data management	,38	,62	1,00	,46	,15	,29	,29	,10
Info and cyber security	,23	,35	,46	1,00	,18	,44	,44	,00
Reg non compliance	,28	,16	,15	,18	1,00	,53	,42	,42
Internal fraud	,18	,20	,29	,44	,53	1,00	,60	,20
Market misconduct	,18	,20	,29	,44	,42	,60	1,00	,40
Product management	,09	,10	,10	,00	,42	,20	,40	1,00
AML	,18	,20	,29	,44	,53	,80	,60	,20
Sanction	,18	,20	,29	,44	,53	,80	,60	,20
External fraud	,22	,34	,48	,74	,18	,51	,51	,00
Anti bribery and corruption	,15	,17	,24	,37	,27	,51	,51	,17

Resulting correlations from the sensitivity of risk drivers

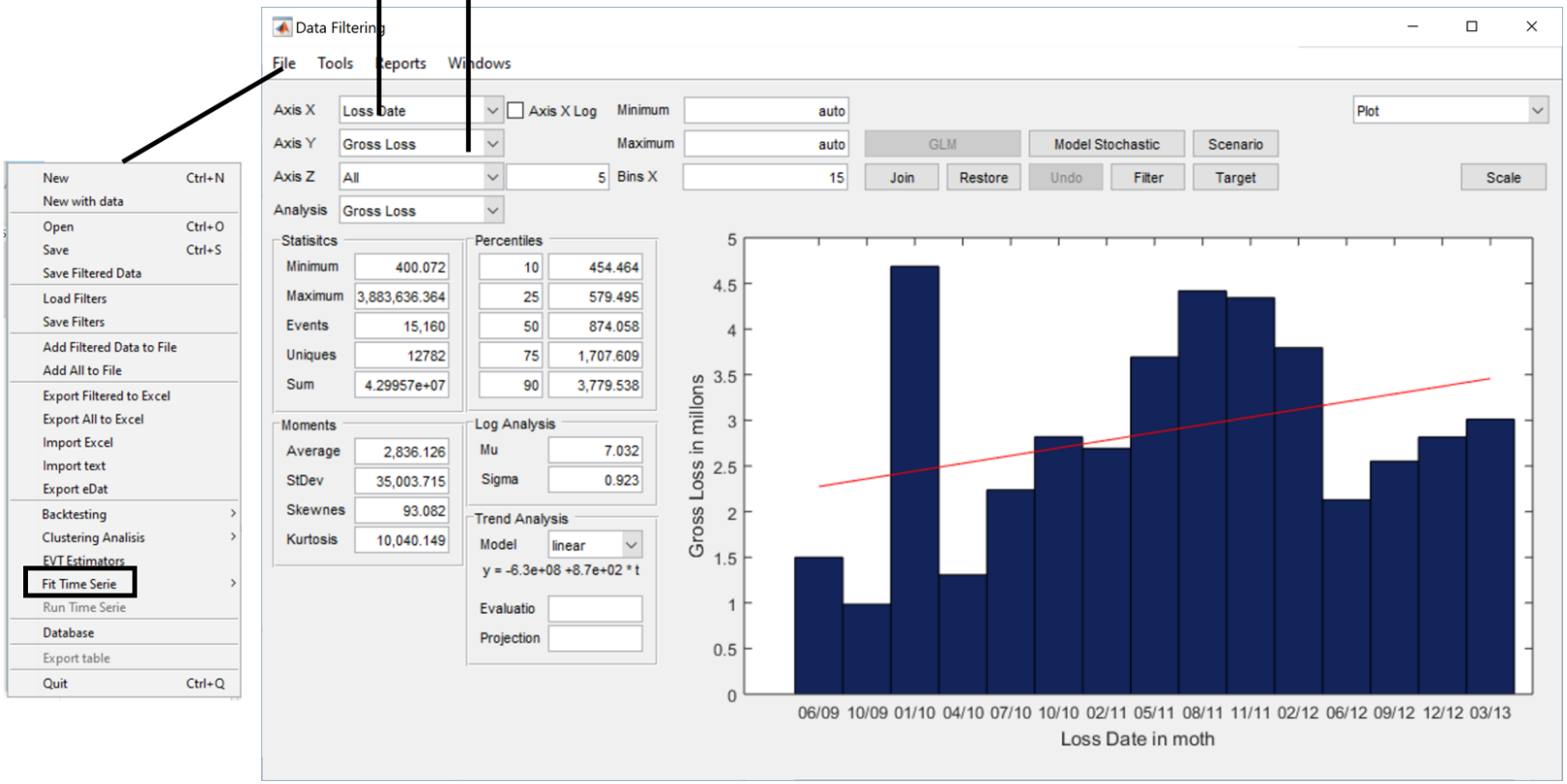
TAB creates directly from the OpRisk database, loss time series for stress testing purposes: time series of total losses, frequencies, tail values or any other metric

Our GRC Analytics automates the creation of times series of los data creating a seamless link with stress testing analysis of macroeconomic variables or other indicators such as KCI, KPI, KRI…

Date field required in Axis X

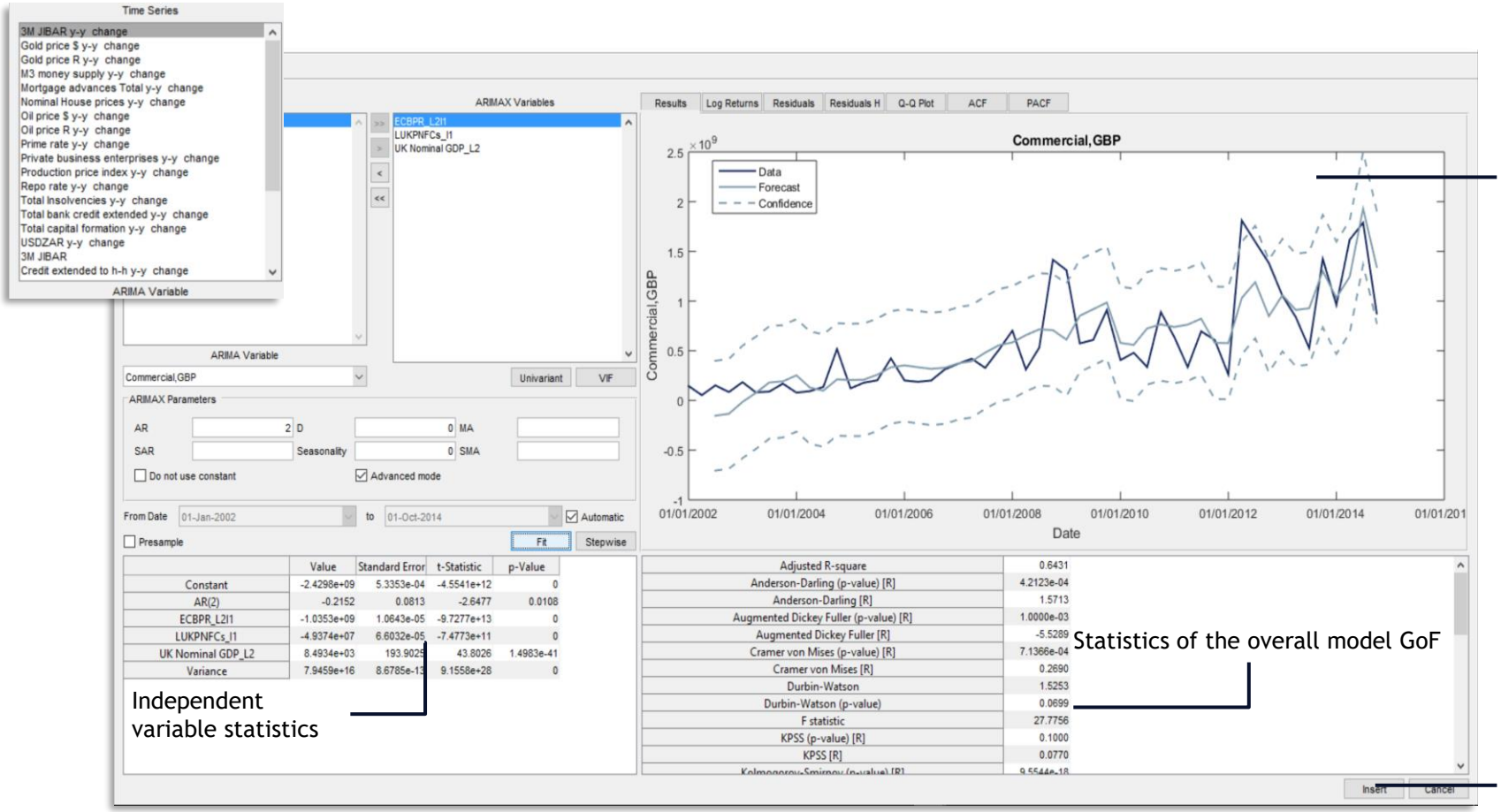
Select a loss amount field or “Events”, in Axis Y

Click to send data to the forecasting model module and to create the loss time serie



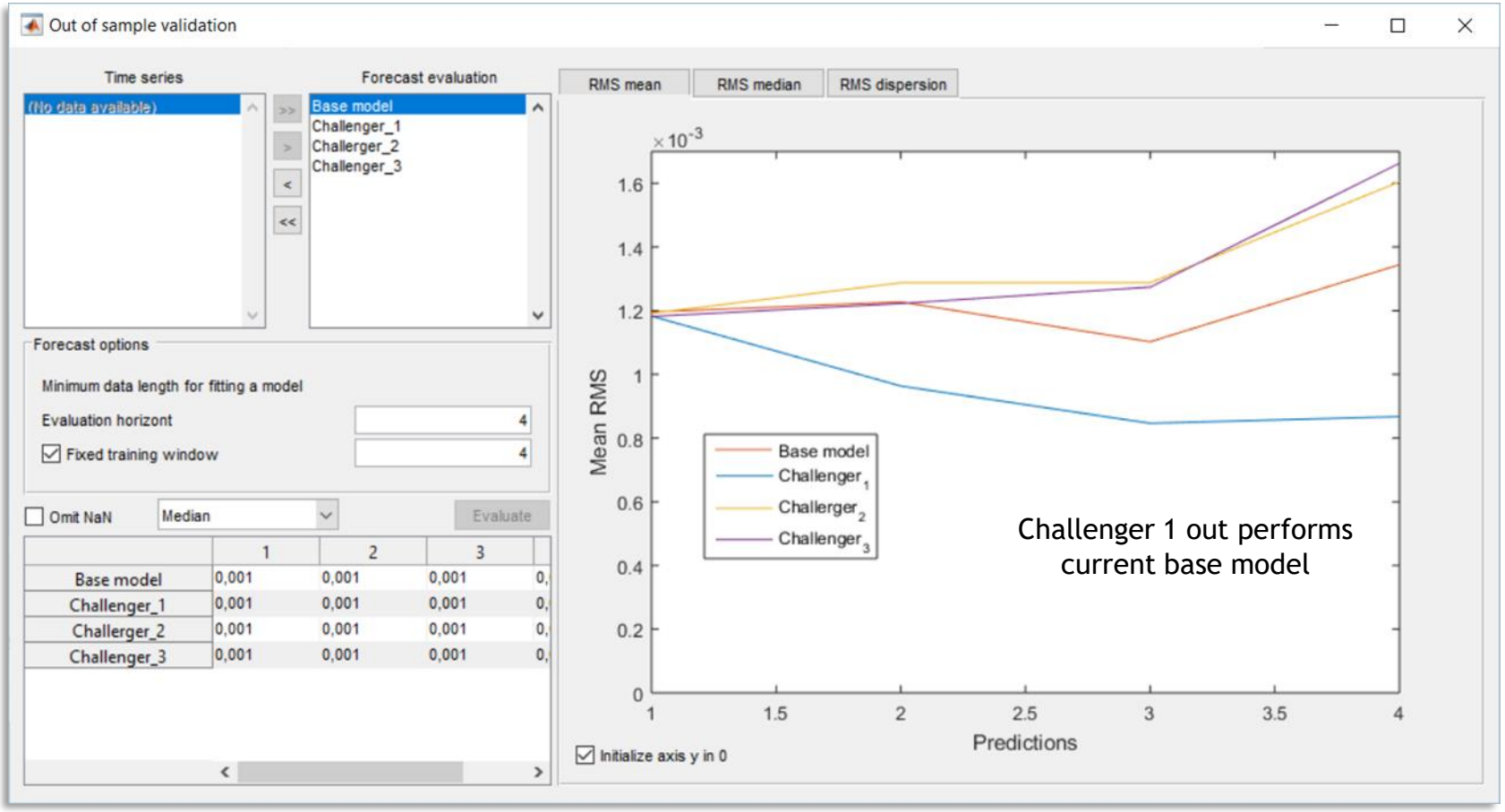
Loss times series are regressed against macroeconomic factors, KRIs, KCIs and other metrics to create loss forecasting macroeconomic models

The models created provide the loss expectation under any type of scenario: base case, stress scenario, severely adverse… permitting its integration into the global stress testing exercise



TAB's GRC Analytics supports a champion multi-challenger approach for identifying forecasting model performing most robust predictions

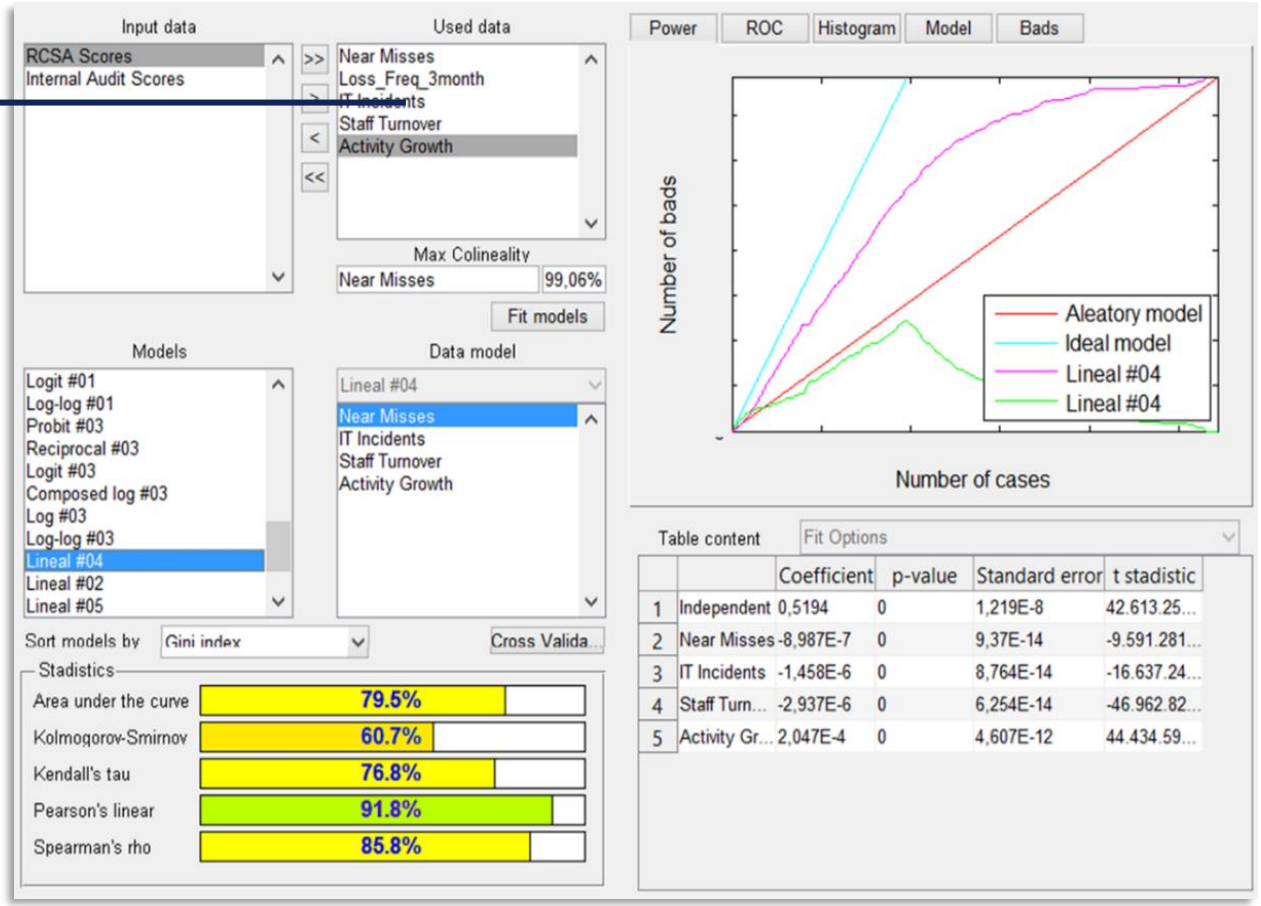
Our solutions provide extensive out-of-sample model validation to confirm the true causality found in the risk factors allowing for a robust and credible projection



TAB provide Machine Learning techniques to predict large losses as different risk indicators change, such as staff turnover IT incidents and other

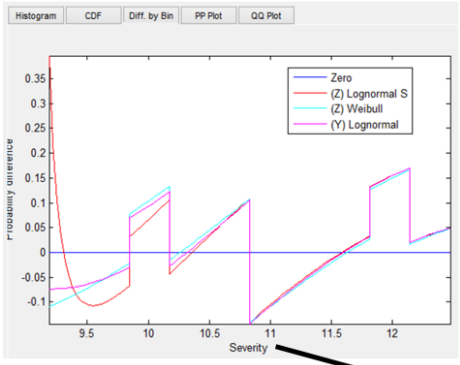
Using machine learning the user may develop models to identify those business units, processes, risk types where is more likely to experience a deterioration of the control environment

Different risk indicators are automatically modelled to select most predictive combination of variables

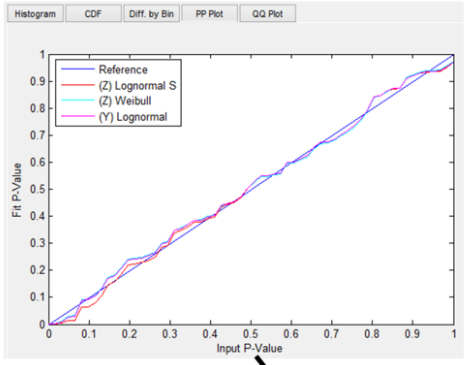


Special focus is given to scientific validation of Analytics both for those data based models as well as expert elicitated models

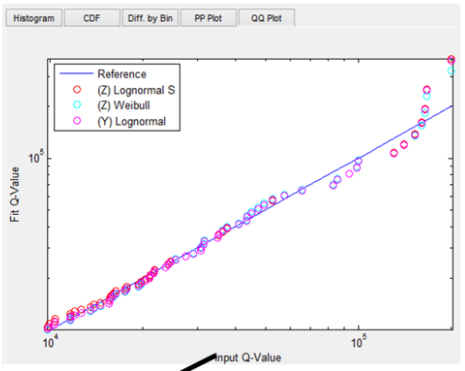
Difference by bin plot



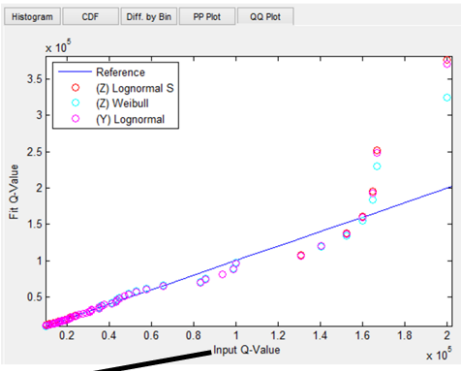
Probability-probability (PP) plot

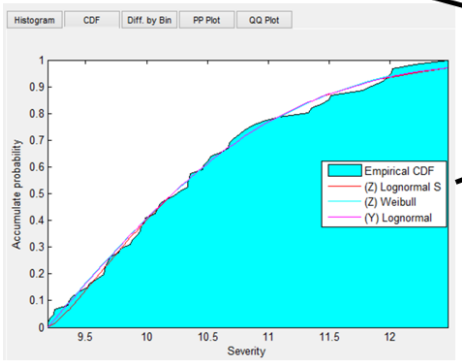


Quantile-quantile (QQ) plot, log scale

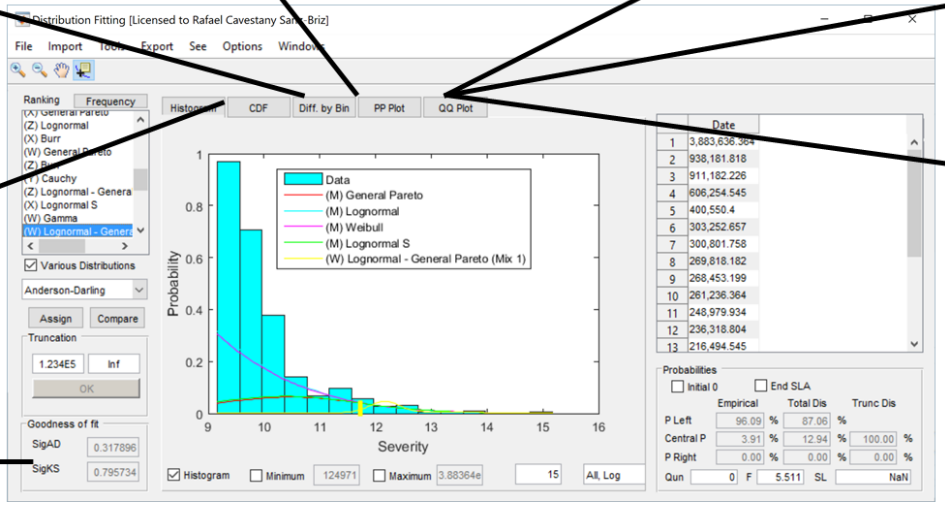


Quantile-quantile (QQ) plot, linear scale

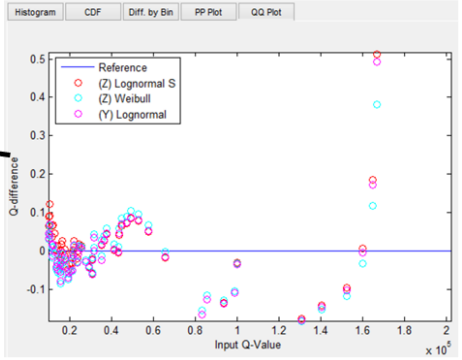




CPF plot



AD and KS P-Values, from the fit

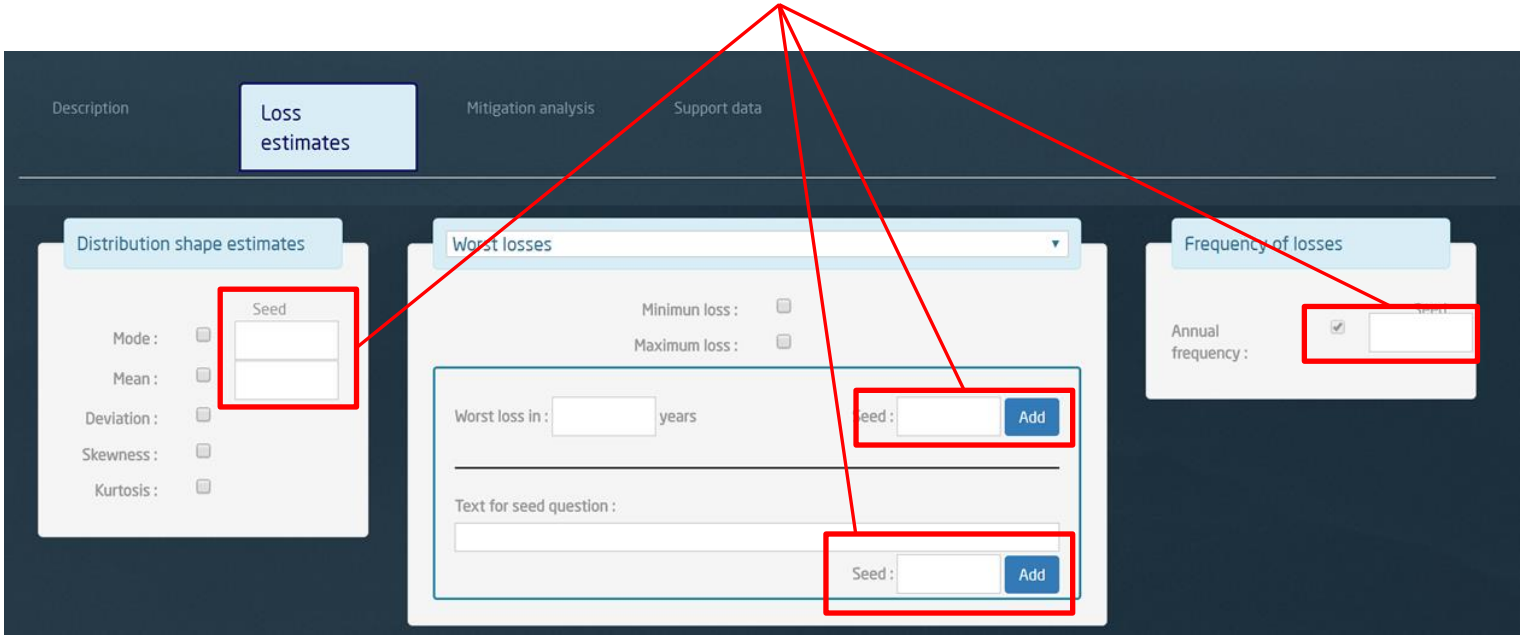


Quantile-quantile (QQ) plot, % differences

Expert judgment requires solid validation and our GRC Analytics use Structured Expert Judgment to validate the quality of the expert based risk evaluations

Seed questions are embedded into the questionnaire to assess the SMEs' skills in evaluating risk events and to weight SME answers accordingly. Seed questions are questions whose answers are known. The performance of experts in seed questions is used to evaluate the skills/knowledge of experts in predicting uncertain events calculating a performance score per participating expert. Such score is used to aggregate the individual answers into an aggregated answer per risk scenario

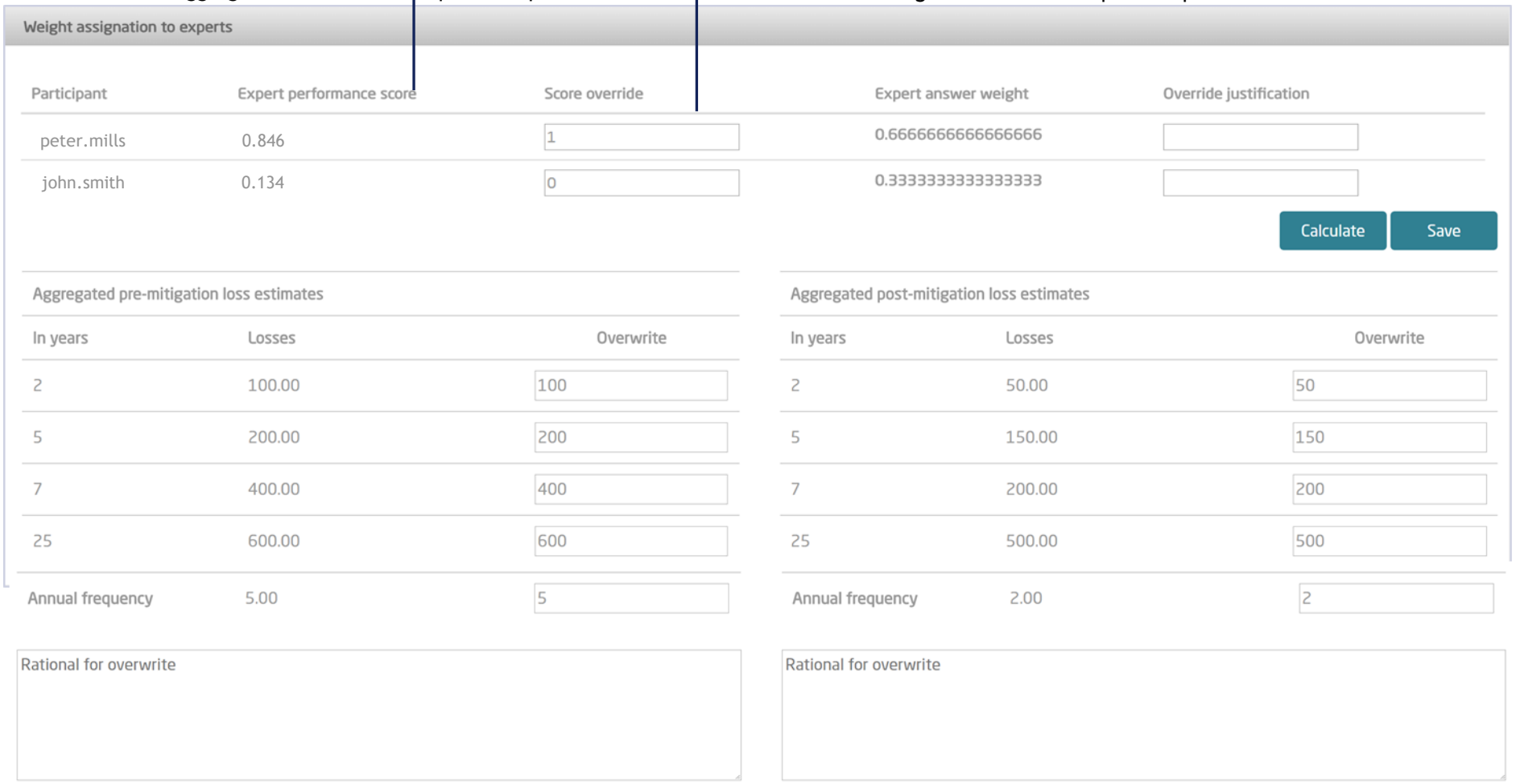
Definition of seed questions into the scenario questionnaire



The SMEs' answers are aggregated based on their seed questions performance and the aggregated answer is used for the modelling

SME answers are aggregated based on seed questions performance

The weight from the seed question performance can be overridden



Weight assignation to experts

Participant	Expert performance score	Score override	Expert answer weight	Override justification
peter.mills	0.846	1	0.6666666666666666	
john.smith	0.134	0	0.3333333333333333	

Calculate Save

Aggregated pre-mitigation loss estimates

In years	Losses	Overwrite
2	100.00	100
5	200.00	200
7	400.00	400
25	600.00	600
Annual frequency	5.00	5

Rational for overwrite

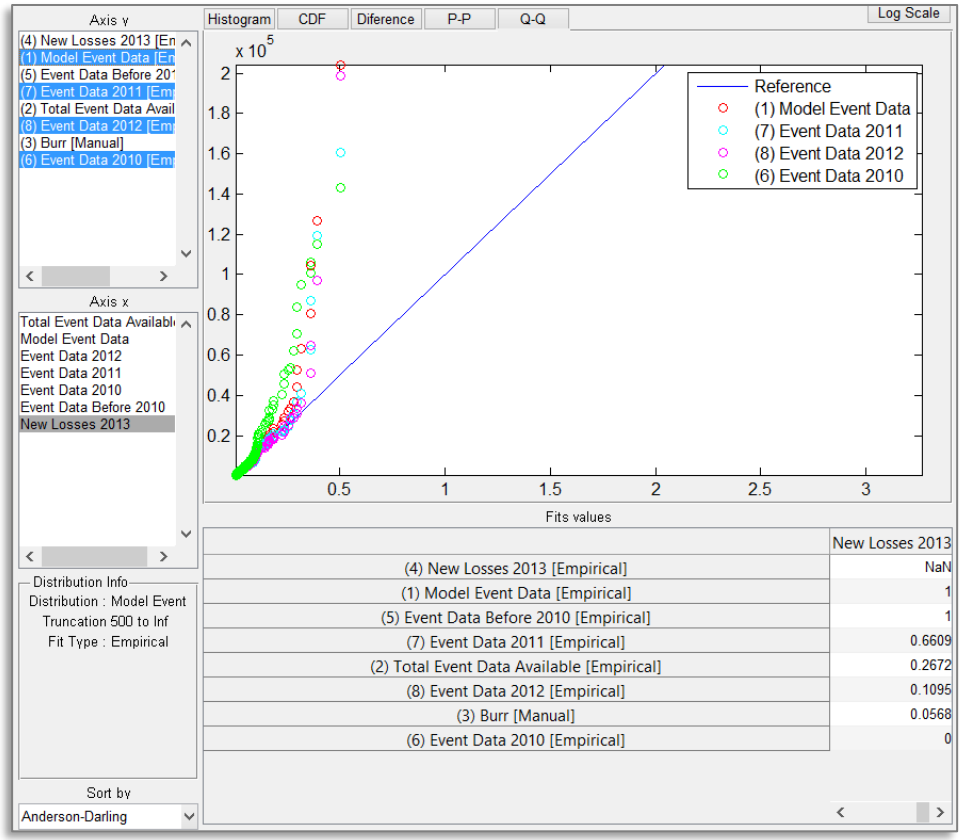
Aggregated post-mitigation loss estimates

In years	Losses	Overwrite
2	50.00	50
5	150.00	150
7	200.00	200
25	500.00	500
Annual frequency	2.00	2

Rational for overwrite

Validation and backtesting

Finally, our solution provides the means to perform validation and backtesting on scenario analysis. The analysis can be done ex-ante, by validating the expert risk assessments against internal or external losses before the capital calculation. It can also be done ex-post, and backtest the capital against the losses materialized in the subsequent periods after the capital requirements calculations.



Backtesting of severity:

- Distribution used to calculate capital compared to new losses
- New losses compared to the losses used to construct the capital model

Backtesting of frequencies:

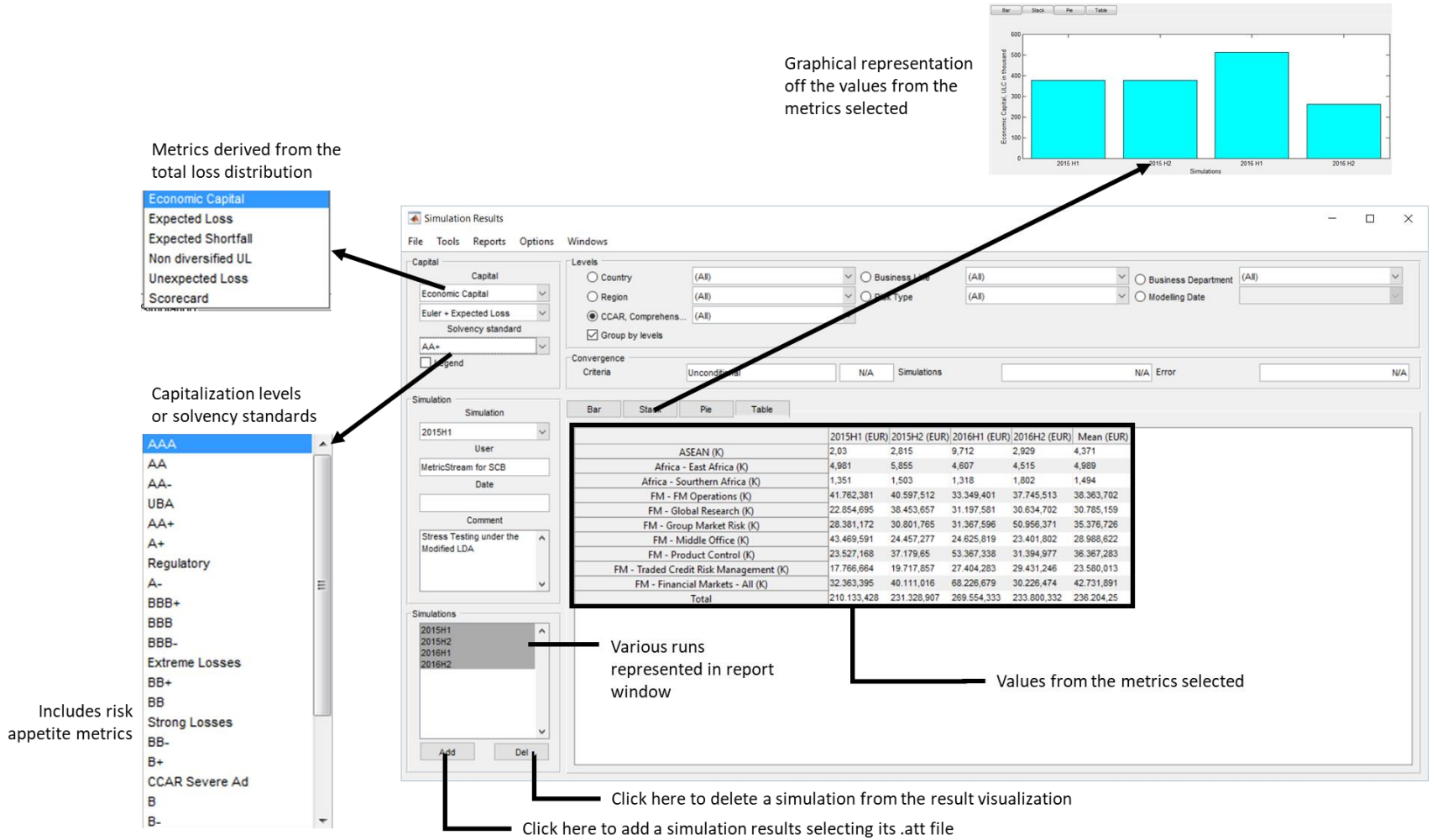
- Violation ratio using UoMs observations

Backtesting of total losses:

- Violation ratio using UoMs observations

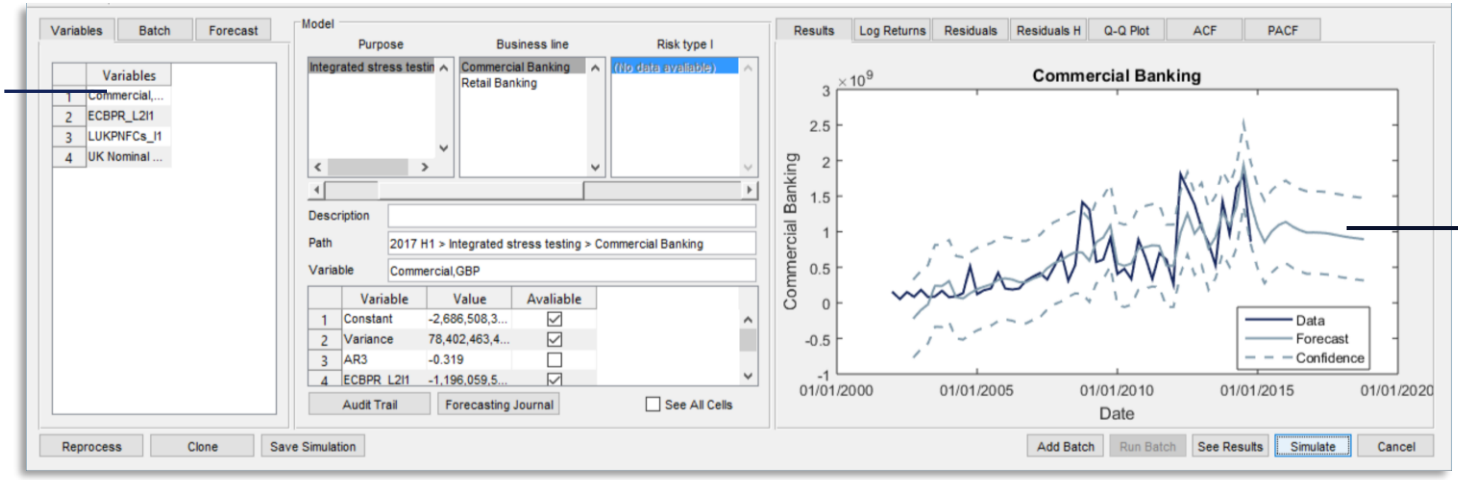
ANNEX B: Risk “monetary value based” management

TAB provides extensive analysis of capital requirements (Basel, Solvency…) and risk appetite metrics under user defined number of confidence levels



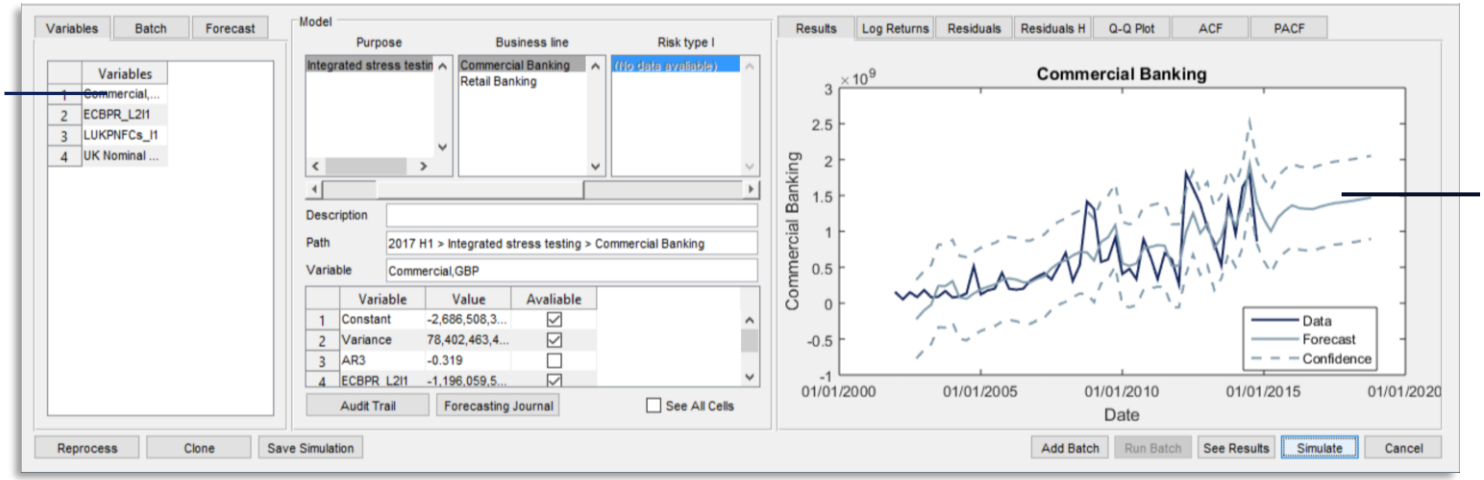
Our stress testing modelling permits to forecast losses under stress or base case scenarios as required

Projected macro variables for a recession scenario



Projection of operational loss under a **recession** scenario

Projected macro variables for an expansion scenario



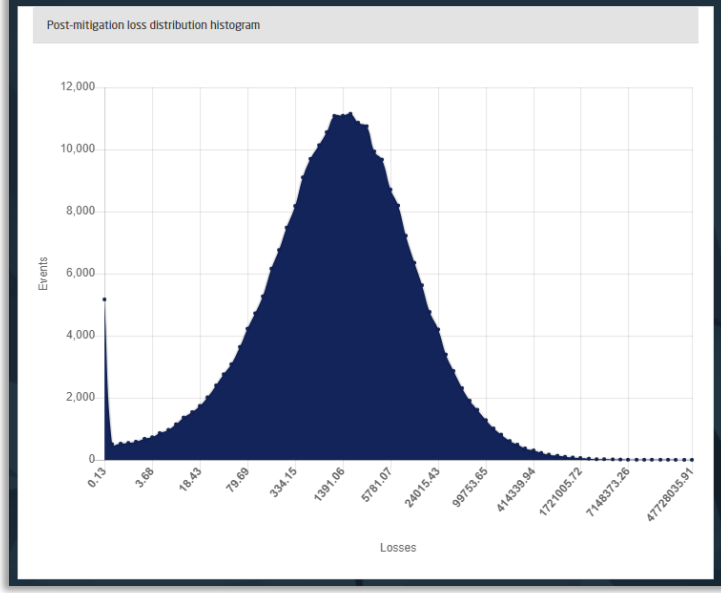
Projection of operational loss under an **expansion** scenario

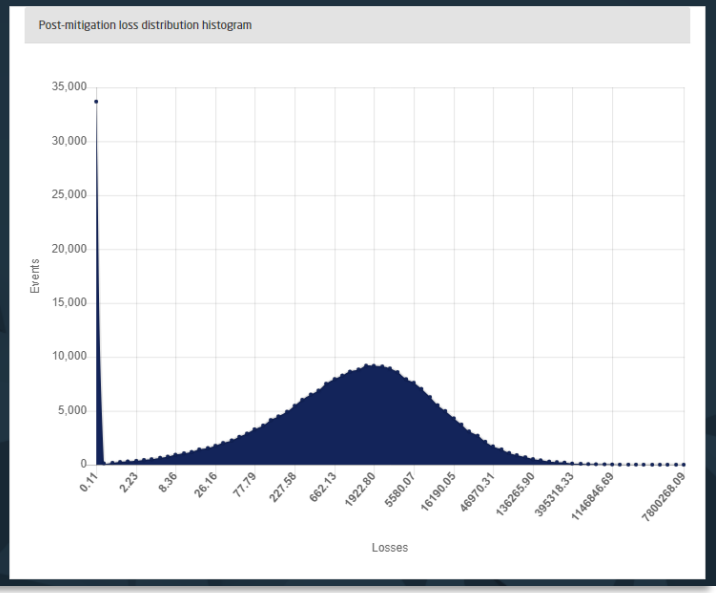
TAB's GRC Analytics integrates measurement and management showing risk profile before and after new mitigation plans and controls

Risk monetary value based management permits to translate risk levels assumed into monetary values generating intuitive risk metrics which facilitate internal decisions and buy-in

Pre-mitigation loss distribution of aggregated answers		
Expected loss :	755,290.25	
Percentile	Stand alone	Diversified
1 in 20 years (95.00 %)	40,285.90	32,228.72
1 in 100 years (99.00 %)	192,677.71	154,142.17
1 in 200 years (99.50 %)	350,946.19	280,756.95
1 in 1,000 years (99.90 %)	1,245,142.43	996,113.94
1 in 2,000 years (99.95 %)	1,947,399.04	1,557,919.23

Post-mitigation loss distribution of aggregated answers		
Expected loss :	327,296.45	
Percentile	Stand alone	Diversified
1 in 20 years (95.00 %)	28,098.13	22,478.50
1 in 100 years (99.00 %)	108,948.16	87,158.53
1 in 200 years (99.50 %)	181,810.17	145,448.14
1 in 1,000 years (99.90 %)	507,962.81	406,370.25
1 in 2,000 years (99.95 %)	809,662.98	647,730.38

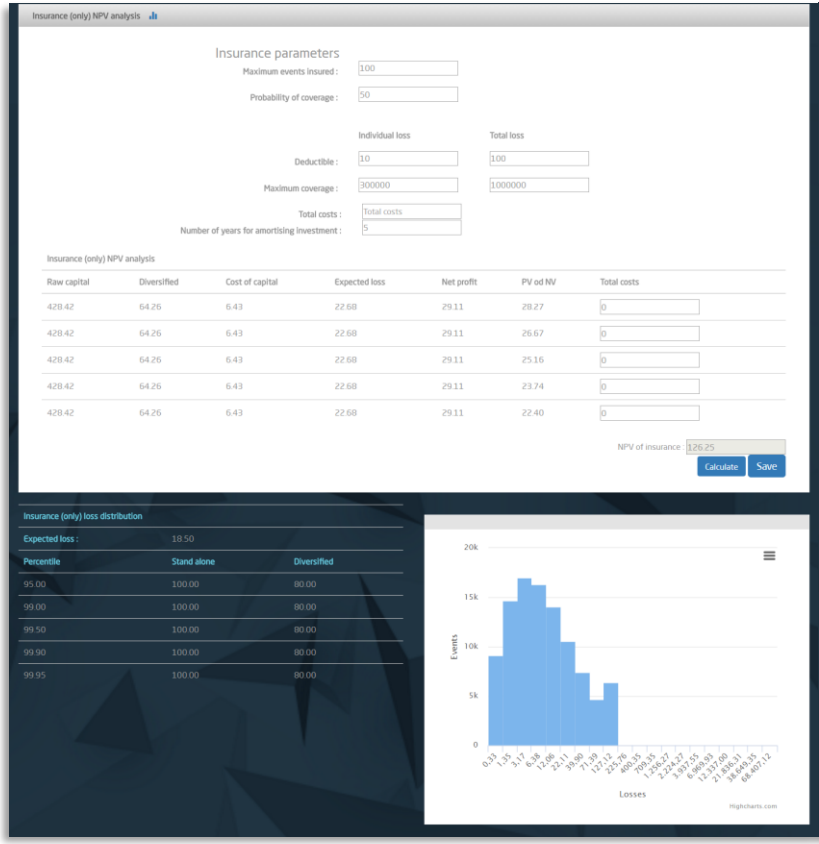




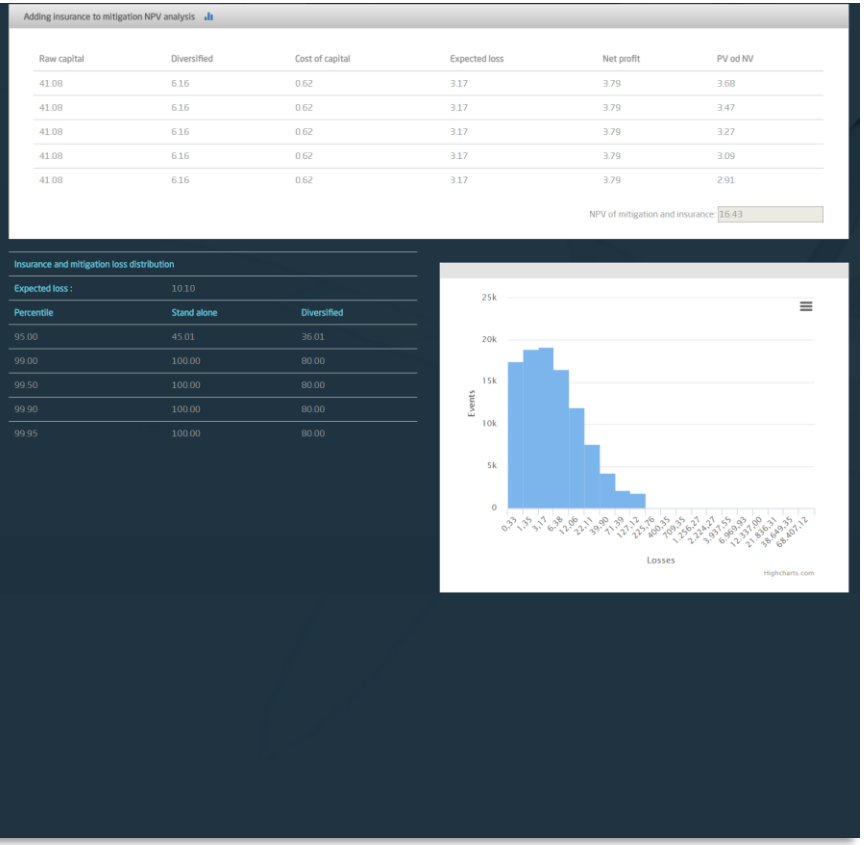
The difference in risk profiles is used, together with controls implementation costs and potential insurance to determine the NPV of mitigation actions

Economic metrics such as NPV (net present value) or capital requirements and better understood by upper management permitting an effective integration of the Risk management program into the daily management of the institution/company

NPV and loss analysis applying insurance only



NPV and loss analysis with insurance in the mitigation plan



Our GRC Analytics provides full reporting functionalities generating an exhaustive regulatory approval report derived from the audit trail with the push of a button

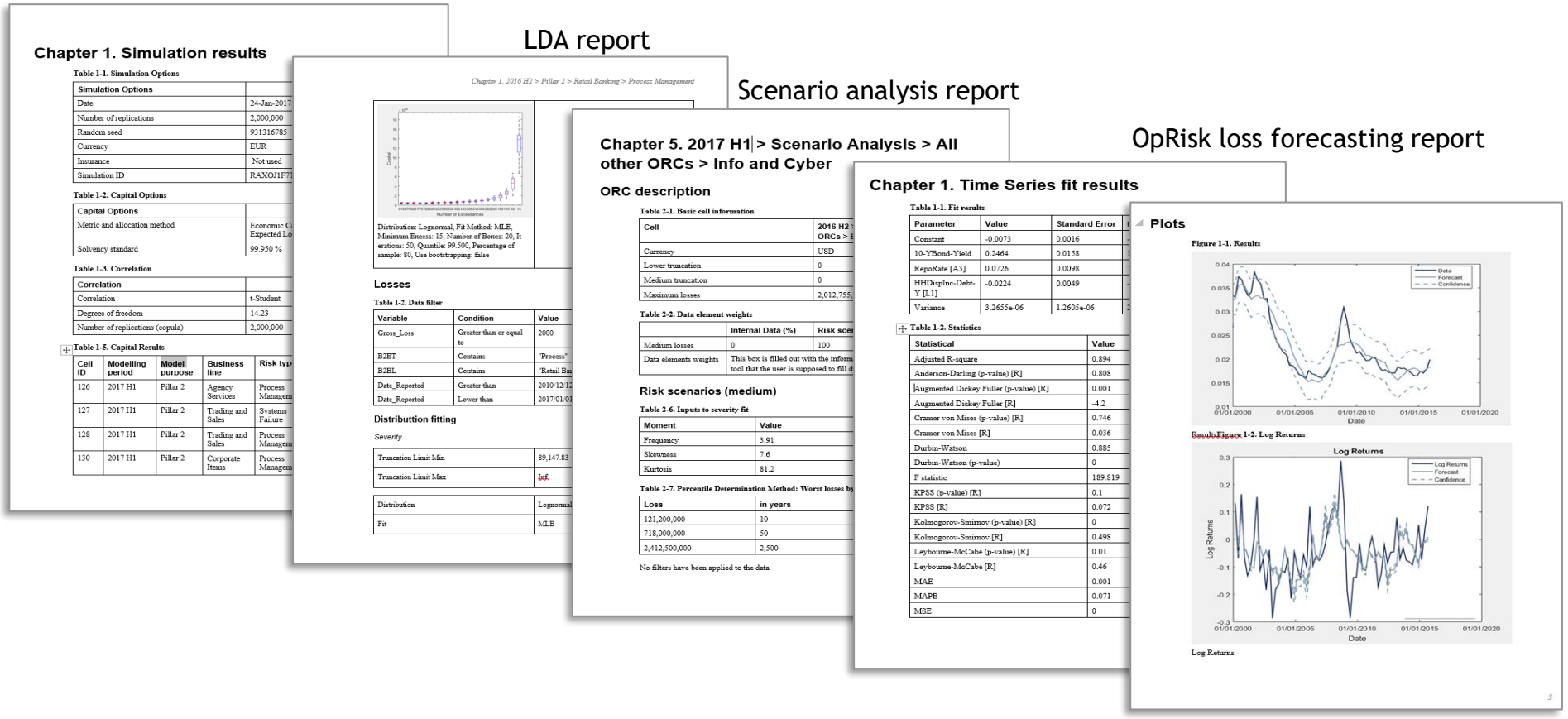
If the regulatory validation report is given to an external analyst such analyst would be able to exactly replicate the model results

Simulation report

LDA report

Scenario analysis report

OpRisk loss forecasting report



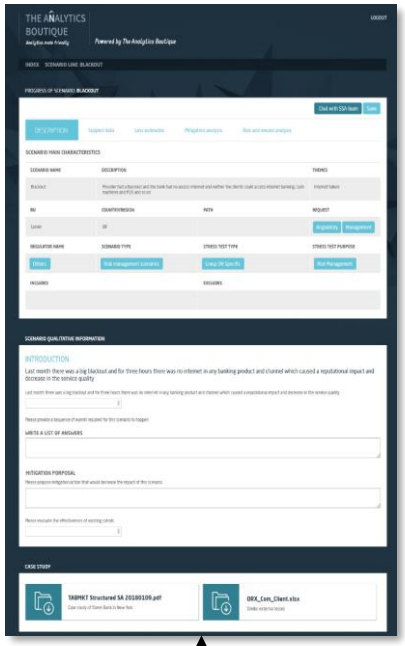
Risk management and measurement data is stored in TAB's GRC Analytics database and can be reported as desired using pivot tables and dashboards

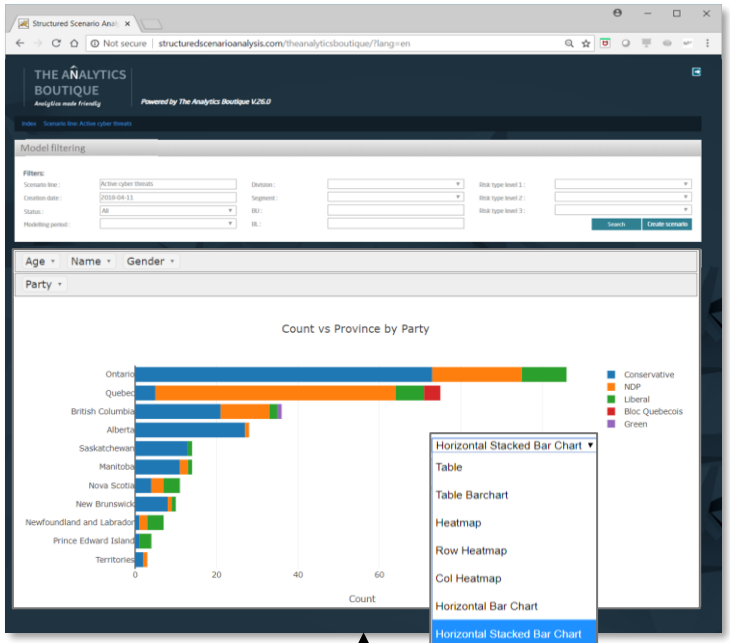
1 Information is captured by users or produced by GRC Analytics forms and stored in a database

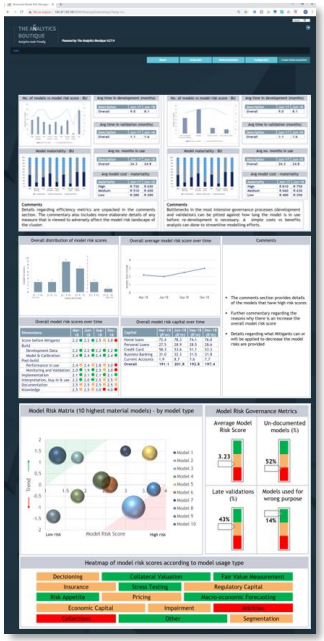
2 Pull information from database and create tables and charts as required using integrated reporting module

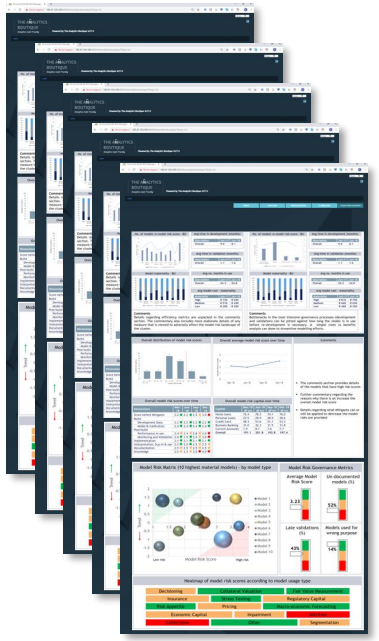
3 Graphs are grouped into dashboards

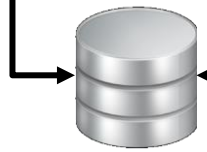
4 Multiple dashboards can be created







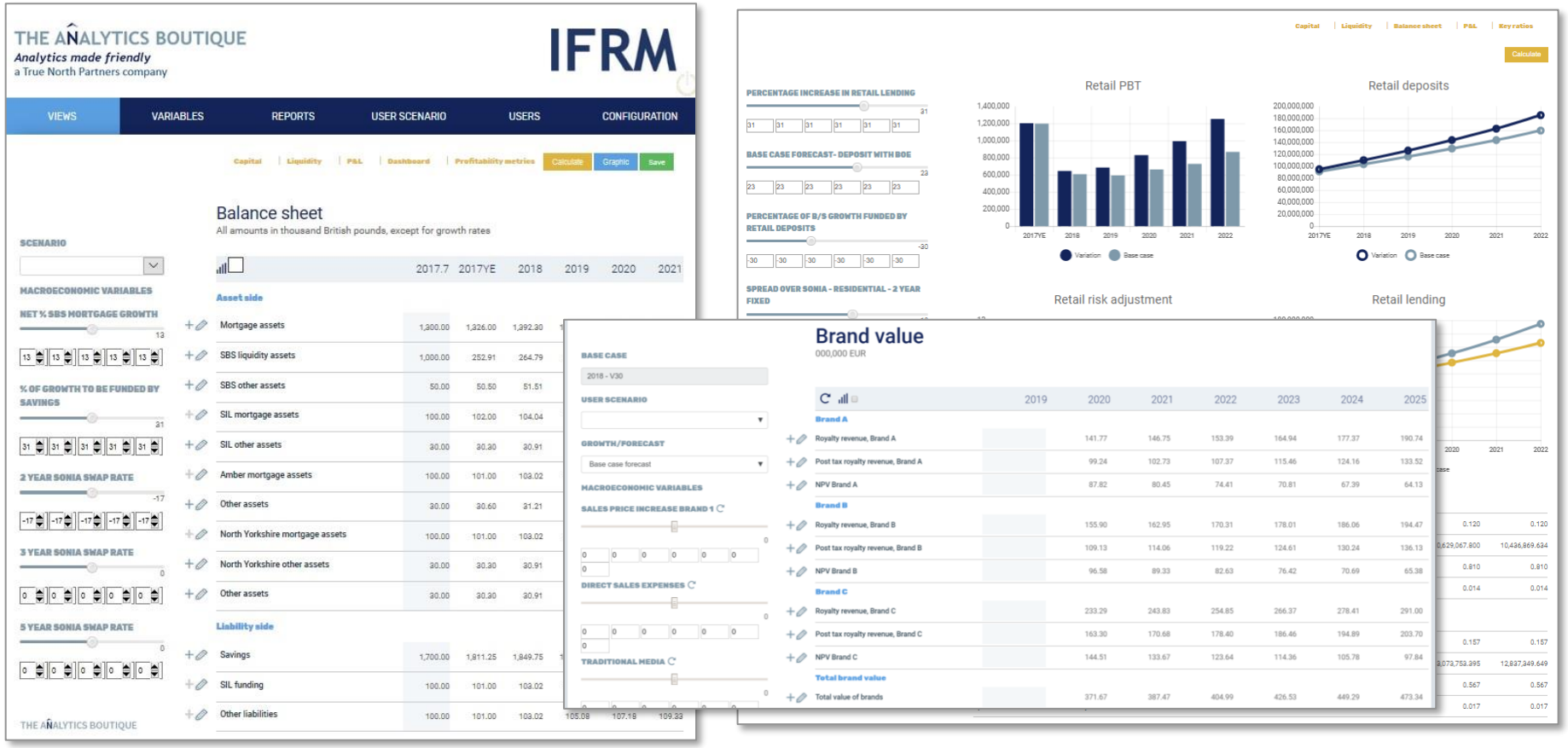




Multiple options available for representation

The created risk analytics models can be integrated into the financial planning of the company using IFRM for projecting P&L, BS and CF under any risk scenario

IFRM (Integrated Financial Resource Management TAB's stress testing and financial planning tool) integrates all risk Analytics such as as models, capital estimation process, stress testing…, into the financial planning process providing a consistent view of financial planning, strategy evaluation and risk measurement



Thank you.

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