Euronext Clearing Model Validation

Risk Policy dept.

EURONEXT CLEARING

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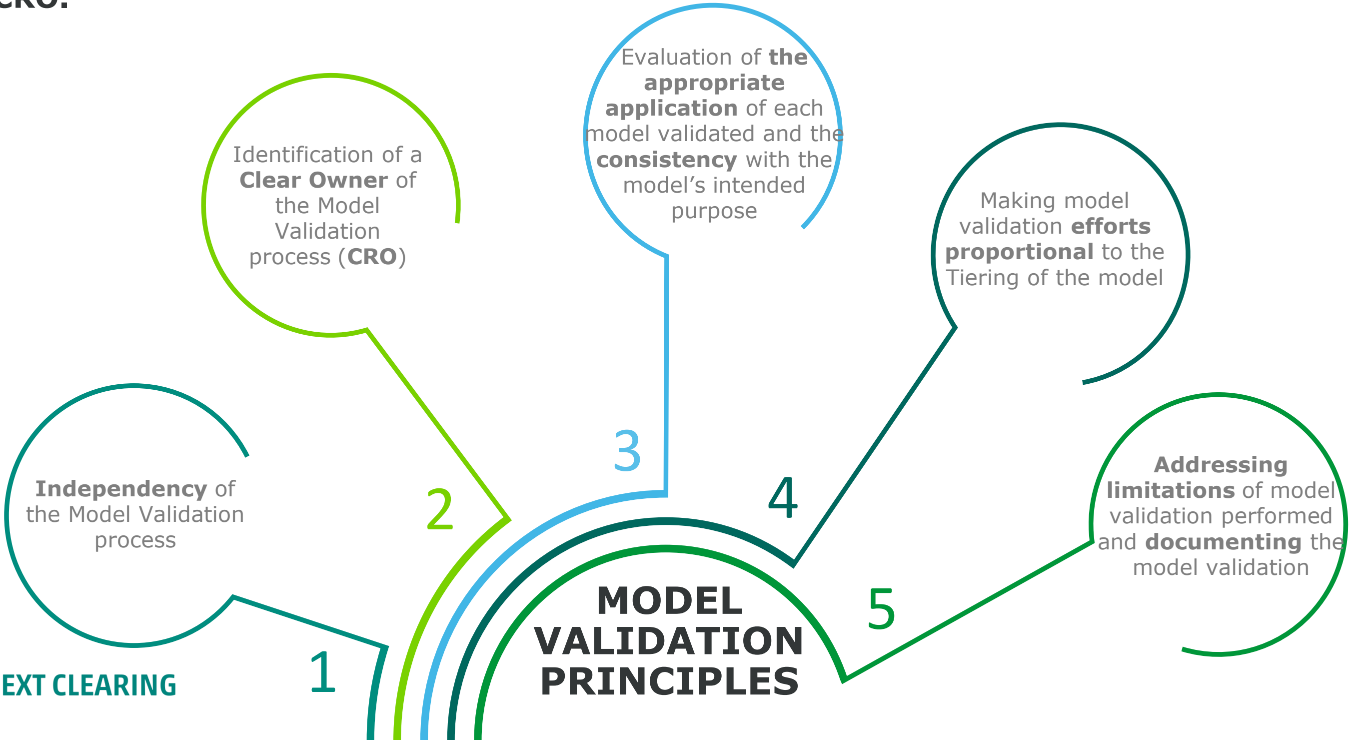
Background – Objective and Principles

- **Model Validation** (MV) is a key area that can help mitigate **Model Risk**, i.e. the risk that a model is not providing accurate output, is being used inappropriately, or that its implementation does not respond to its primary objectives.
- In Euronext Clearing Models are developed and maintained by the **Risk management** dept. (First Line) and validated by the **Risk Policy** dept., **a dedicated Second Line function independent from the First, reporting to the CRO.**



Model Validation Features

- The independent Model Validation is performed on a regular basis and before a new model or a significant change to an existing model is implemented.

- Each model is assigned a **Tier** based on documented criteria. The Tier level determines the **prioritization** of validation activities and escalation of issues.

- Model Validation combine qualitative and quantitative analysis; for the quantitative analysis **internal tools** are employed, developed by means of different programming software. Availing of internal tools can help to:

  - ✓ Provide a **fully automated** solution (also in terms of input data feed and output reporting),
  - ✓ Provide a **flexible** solution (easily adapted if some minor changes occur),
  - ✓ **Validate** and **challenge** (e.g. via stress test analysis) all model components,
  - ✓ **Compare** the model outcomes with market best practice/comparable models results,
  - ✓ Produce **evidences** and **report** the outcomes of the analysis performed.

Model Validation Process

In a nutshell

1 Framework soundness and adequacy

- Check **Regulatory Compliance**
- Check the **adequacy** of the Model to the **intended purposes** (markets, liquidity, credit risk,…)
- Identify model sources of uncertainty (**limitations and assumptions**)
- Assess the adequacy and the completeness of **Model Documentation**
- Verify the consistency of **Model Governance**

2 Validation of Model components

Input component:

- Gap analysis
- Freshness analysis
- Swing analysis

Implementation component:

- Bug detection
- Model replica
- Level of automatization

Output component:

- Backtesting, sensitivity test, Stress test and Reverse stress test
- Procyclicality assessment
- Model Benchmarking

3 Analysis of the outcomes

Model **issues classification**:

- Soundness
- Implementation
- Documentation

Model issues are ranked based on their *Materiality*, which in turn depends on pre-defined criteria.

An **overall RAG** (Model's risk rating) is assigned to each Model, based on the identified issues.

4 Reporting and maintenance

- Drafting **detailed MV Reports** and supporting documentation
- **Escalation of results** to the relevant stakeholders**, including the BoD and the Authorities**
- Maintenance of the **Models' Inventory**
- **Corrective Actions** Plan and tracking

To effectively deliver Model Validation goals, each step of the process requires a strong collaboration between developers and validators

Model Validation activities

Some examples

Statistical backtests

Backtest - in its simplest form - count the number of times the actual returns fall outside the Margin Model estimate and compare it to the desired/expected number of exceptions.

Backtests based on breaches counting can heavily depend on the sample of actual returns. To address this limitation, the assessment of the model coverage is enriched by **a set of statistical back testing procedures** which also give useful information about breach magnitude and distribution.

The suite of statistical backtests include *Frequency tests* (Kupiec), *Independence tests* (Christoffersen, Haas) and, where applicable, more sophisticated methodologies (Acerbi-Székely).

Procyclicality analysis

EMIR requires CCPs to regularly monitor and, if necessary, revise the level of margins to reflect current market conditions, considering any procyclical effects of such revisions.

Risk Policy performs anti-procyclicality analysis, by employing a set of **procyclicality metrics** capturing both short and long-term margins behaviors.

Model Replica

Risk Policy implemented an independent Replica of the main Margin Models and Stress Test methodologies.

A model's Replica allows not only to have a clear insight on each model component, but also to spot data inconsistencies or implementation issues.

Model Validation activities

Model benchmarking

- Where appropriate, Margin Models’ output is benchmarked against a wide set of **benchmark models.**
- Margin Benchmark models include a set of **Value at Risk**[1] (VaR) methodologies as well as **SPAN** methodologies.

	Variance-Covariance VaR	Historical VaR	SPAN (Standardized Portoflio Analysis of Risk)	Monte Carlo VaR
Description	For each portfolio, determines the amount of potential loss (VaR) that can occur with probability 1-CL over HP days.	For each portfolio, determines the amount of potential loss (VaR) that can occur with probability 1-CL over HP days, by ranking historical returns from lowest to highest.	The overall risk exposure is determined by mapping instruments in classes with statistically significant correlation in terms of risk factors variation.	Estimates VaR by simulating random scenarios, revaluing instruments in the portfolio and selecting the CL-percentile of simulated values.
What’s Inside	**Cash-flow mapping:** Map every instrument (principal and coupon amounts) of the portfolio in the appropriate nodes based on Duration. **VaR calculation:** Given the present value of x of the future cash payments and the portfolio variance-covariance matrix Σ, $VaR = \alpha\sqrt{x'\Sigma x}$, where α is the normal distribution quantile.	All yield input data are converted into prices p For each node j=1,…,n and t=1,…,m day of the time series, given the current price p_{curr}, the following price variations are computed $p^j_{curr}\frac{p^j_t}{p^j_{t-hp}}$ The portfolio is fully re-evaluated by multiplying the notional amount allocated to each node by the related price scenario and then selecting the CL-percentile.	For Equity/Derivatives markets, mapping is based on instrument’s underlying. For Fixed Income markets, the mapping criteria is based on bond’s duration. Each SPAN class has its own risk measure based on the observation of risk factors’ historical time series.	▪ Select a stochastic process for yields: $y_t = f(t) + \varepsilon_t$. ▪ Compute yields at T+1 for N_{sim} times (Nelson Siegel Model). ▪ VaR is the CL-percentile of the N_{sim} portfolio value variations.
Pros	▪ Fast and simple to calculate. ▪ Needs only correlations of risk factors as input.	▪ No assumptions on distribution.	▪ Standardized across CCPs. ▪ Proven track record of efficiency during stressed periods.	▪ Converges to the solution. ▪ Future can behave differently from the past.
Cons	▪ Normality assumption on portfolio returns.	▪ No distribution to help determine future returns. ▪ Assumes future will behave like the past.	▪ Correlation between products is not directly managed. ▪ It hardly conforms to increasing market complexity.	▪ High computational effort. ▪ Needed calibration of parameters.

(1) VaR benchmark models include both *local* and *full valuation* methodologies. In *full-valuation* portfolios are repriced over a wide range of scenarios, while in *local-valuation* portfolios are revalued only once, at the initial position and local derivatives are used to infer possible movements.

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Regulatory Framework

EMIR, Article 49 (1) (Review of models, stress testing and back testing):
"A CCP shall regularly review the models and parameters adopted to calculate its margin requirements, default fund contributions, collateral requirements and other risk control mechanisms. It shall subject the models to rigorous and frequent stress tests to assess their resilience in extreme but plausible market conditions and shall perform back tests to assess the reliability of the methodology adopted. The CCP shall obtain independent validation, shall inform its competent authority and ESMA of the results of the tests performed and shall obtain their validation […] before adopting any significant change to the models and parameters."

ESMA RTS No. 153/2013, Section 1 (Models and Programmes), Article 47 (1) (Model Validation):
"A CCP shall conduct a comprehensive validation of its models, their methodologies and the liquidity risk management framework used to quantify, aggregate, and manage its risks. Any material revisions or adjustments to its models, their methodologies and the liquidity risk management framework shall be subject to appropriate governance, including seeking advice from the risk committee, and validated by a qualified and independent party prior to application."

CPMI-IOSCO Principles for Financial Market Infrastructures (2012), Principle (3.2.16):
"The board should ensure that there is adequate governance surrounding the adoption and use of models, such as for credit, collateral, margining, and liquidity risk-management systems. An FMI should validate, on an ongoing basis, the models and their methodologies used to quantify, aggregate, and manage the FMI's risks. The validation process should be independent of the development, implementation, and operation of the models and their methodologies, and the validation process should be subjected to an independent review of its adequacy and effectiveness. Validation should include (a) an evaluation of the conceptual soundness of (including developmental evidence supporting) the models, (b) an ongoing monitoring process that includes verification of processes and benchmarking, and (c) an analysis of outcomes that includes back testing."

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