IRB PD Periodic Model Validation

Quantitative Testing Procedures

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Periodic Model Validation

- Periodic model validation is a critical part of the Probability of Default (PD) model lifecycle.
- It typically refers to a robust system consisting of clearly defined tests and processes that assess whether the model under investigation is still suitable for its intended purpose.
- A common practice is to split the validation process into quantitative and qualitative procedures.
- The following slides provide a brief overview of specific areas related to quantitative validation procedures. Although different approaches exist in practice, one approach is to group procedures into three main areas:
  - model structure;
  - model calibration (sometimes referred to as backtesting or review of estimates);
  - Margin of Conservatism (MoC) challengers.

PD Model Structure

The tests and metrics used in this area of investigation aim to assess whether the model sufficiently differentiates risk between observations in the validation sample. In general, various aspects of the model are validated, such as:

- changes in discriminatory power over time;
- stability of risk factors and model output;
- representativeness;
- heterogeneity of the rating scale;
- homogeneity of the rating scale;
- concentration in the rating grades and risk factor modalities.

Some of the most commonly applied statistical metrics and tests for this purpose include:

- Area Under the Receiver Operating Characteristics Curve (AUC);
- test of proportions (1-sample, 2-samples);
- Population Stability Index (PSI);
- Herfindahl-Hirschman Index (HHI).

Model Calibration

The model calibration is closely related to risk quantification process. It assesses the predictive power of the model in use. The predictive power analysis aims to ensure that the PD parameter accurately predicts the occurrence of defaults, meaning that PD estimates provide reliable forecasts of default rates.

In practice, the four statistical tests are commonly used, and they are:

- exact binomial test;
- Jeffreys' test;
- z-score test;
- Hosmer-Lemeshow test.

Only the Hosmer-Lemeshow test is designed for the overall rating scale, while others are usually applied on the level of the rating grade and portfolio level.

Margin of Conservatism Challengers

Due to the variety of possible sources of model uncertainty, challengers of the margin of conservatism typically focus on uncertainty arising from general estimation error. These challenges are usually based on the variability of long-run default rates (at the portfolio or rating grade level) and primarily rely on the confidence interval of binomial proportions but may also incorporate other methods.

Some commonly applied statistical approaches include:

- empirical quantiles;
- Clopper-Pearson confidence interval;
- Jeffreys' confidence interval;
- normal-based approximated confidence interval;
- Pluto-Tasche methods;
- Benjamin-Cathcart-Ryan approach;
- Alan Forrest's approach.

Concluding Remarks

- The primary purpose of periodic model validation is to determine whether the model under investigation remains suitable for its intended purpose by examining various aspects of the model.
- Periodic model validation involves clearly defined qualitative and quantitative testing procedures.
- Properly defined testing hypotheses are a strong foundation for effective validation. Practitioners should ensure that these hypotheses are correctly formulated and support the validation process.
- Each statistical test used in the quantitative analysis relies on specific assumptions that practitioners should be aware of when implementing and interpreting the results.
- In addition to considering the results based on the p-value of statistical tests, practitioners should also consider measures of practical significance. More details on p-values and statistical tests are available here.
- Even favorable p-values should not be accepted blindly without further investigation. More details on favorable p-values are available here.