Risk-Weighted Assets as a Function of Probability of Default

Enhancing the Model Validation Process

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Risk-Weighted Assets in IRB Modeling

- Risk-Weighted Assets (RWA) is a measure used to determine the minimum capital required for banks to absorb potential losses.
- Under the Internal Ratings-Based (IRB) approach, RWA is calculated based on a bank's own estimates of risk parameters, including Probability of Default (PD), Loss Given Default (LGD), and Exposure at Default (EAD).
- In the IRB formulas, PD directly impacts the calculated RWA.
- When PD is underestimated, RWA may also be lower than necessary, potentially leading to insufficient capital to cover unexpected losses.
- If PD increases (or is recalculated to a more accurate, higher value), the corresponding RWA will increase, affecting the capital requirements.
- Beyond the standard use of RWA formulas for determining minimum capital requirements, RWA can support model validation by highlighting the impact of potential under- or overestimation of risk parameters.
- The following slides present a simplified simulation design illustrating the change in RWA for a specific increase in PD. Though simplified, this simulation provides a solid foundation for further adjustments. Practitioners are encouraged to adapt the design to meet specific needs.

Simulation Design

Exposure Type and RWA Formula

Residential mortgage exposures:

$$R = 0.15$$

$$K = LGD \cdot N\left[\frac{G(PD)}{\sqrt{1-R}} + \sqrt{\frac{R}{1-R}} \cdot G(0.999)\right] - PD \cdot \text{LGD}$$

$$RWA = K \cdot 12.5 \cdot EAD$$

where:

- R denotes the asset correlation;
- K is capital requirement;
- G is the quantile function of the standard normal distribution;
- PD, LGD, EAD denote risk parameters.

Dataset

```
##   Rating     PD  LGD EAD
##    RG_01 0.0003 0.45 100
##    RG_02 0.0005 0.45 100
##    RG_03 0.0010 0.45 100
##    RG_04 0.0025 0.45 100
##    RG_05 0.0040 0.45 100
##    RG_06 0.0050 0.45 100
##    RG_07 0.0075 0.45 100
##    RG_08 0.0100 0.45 100
##    RG_09 0.0130 0.45 100
##    RG_10 0.0150 0.45 100
##    RG_11 0.0200 0.45 100
##    RG_12 0.0250 0.45 100
##    RG_13 0.0300 0.45 100
##    RG_14 0.0400 0.45 100
##    RG_15 0.0500 0.45 100
##    RG_16 0.0600 0.45 100
##    RG_17 0.1000 0.45 100
##    RG_18 0.1500 0.45 100
##    RG_19 0.2000 0.45 100
```

Simulation Design cont.

1. Using the data inputs and formulas provided on the previous slide, calculate the initial RWA value ($\text{RWA}_{initial}$).
2. Define the PD multipliers as a range of values between 1.01 and 4.
3. Apply each multiplier in the defined range to increase the initial PDs.
4. For each simulated PD, calculate the new RWA.
5. For each new RWA, calculate the RWA change as follows:

$$\Delta\text{RWA} = \frac{\text{RWA}_{simulated} - \text{RWA}_{initial}}{\text{RWA}_{initial}}$$

6. Plot the RWA change as a function of PD.

This design allows practitioners to assess the effect of different PD levels on RWA changes. By defining acceptable RWA change thresholds, practitioners can enhance the model validation process, ultimately supporting the final decision on validation outcomes.

Simulation Results

Rating	PD	LGD	EAD	RWA_initial
RG_01	0.0003	0.45	100	4.1492
RG_02	0.0005	0.45	100	6.2302
RG_03	0.0010	0.45	100	10.6896
RG_04	0.0025	0.45	100	21.2975
RG_05	0.0040	0.45	100	29.9447
RG_06	0.0050	0.45	100	35.0792
RG_07	0.0075	0.45	100	46.4635
RG_08	0.0100	0.45	100	56.3989
RG_09	0.0130	0.45	100	66.9950
RG_10	0.0150	0.45	100	73.4441
RG_11	0.0200	0.45	100	87.9350
RG_12	0.0250	0.45	100	100.6391
RG_13	0.0300	0.45	100	111.9876
RG_14	0.0400	0.45	100	131.6309
RG_15	0.0500	0.45	100	148.2221
RG_16	0.0600	0.45	100	162.5188
RG_17	0.1000	0.45	100	204.4105
RG_18	0.1500	0.45	100	235.7225
RG_19	0.2000	0.45	100	253.1188

Simulation Results cont.