BANKING METRICS · EPISODE 11

BANKING METRICS SERIES · CREDIT RISK TOPIC

THE IRB FORMULA

One PD, one LGD, one equation — how Basel turns a borrower's default probability into the capital a bank holds.

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Capital for the unexpected losses

Under IRB a risk weight is computed from three estimates the bank makes itself.

The formula takes three inputs the bank produces for every exposure and turns them into the capital it must hold. Its job is to size the loss the bank does not expect — the part beyond the average expected loss.

PD DEFAULT RISK	**Probability of default.** The chance the borrower defaults within one year, estimated from the bank's own rating models.
LGD LOSS RATE	**Loss given default.** The share of the exposure actually lost if default happens, after execution of collateral and recovery.
EAD EXPOSURE	**Exposure at default.** How much will still be outstanding at the moment of default, including likely further drawdowns.

Why capital covers only the unexpected loss

Expected loss — PD × LGD — is the average loss the bank already knows it will take, and it is covered by provisions, not capital. The formula subtracts that average and charges capital only for the unexpected loss: how much worse than average a genuinely bad year can turn out to be.

A 99.9% Stress on One Shared Factor

Behind the formula sits one idea: every borrower is pulled by the same economy.
Push the economy to its worst year in a thousand and count who defaults.

The principle: one factor, fully diversified

The formula rests on the Vasicek single-factor model (the ASRF model). One systematic factor, the economy, drives every borrower, and in a large, diversified book each loan's own idiosyncratic risk disappears. That is what makes capital portfolio-invariant: the charge for one loan does not depend on the rest of the book, so one formula can be applied loan by loan.

$$\text{Conditional PD} = N\left[\left(N^{-1}(PD) + \sqrt{R}\cdot N^{-1}(0.999)\right) \div \sqrt{(1-R)}\right]$$
$$K = LGD\,(\text{Conditional PD} - PD)$$

What each piece does

- **The 99.9% —** a one-in-a-thousand bad year. $N^{-1}(0.999) \approx 3.09$ is how far the economy is pushed down.
- **Asset correlation R —** how tightly the borrower moves with the economy. Basel rules fix it: for example the value is between 0.24 and 0.12 for corporates, falling as PD rises.
- **Maturity adjustment —** longer loans can migrate to worse ratings before they mature, so the formula adds capital for maturity beyond one year.
- **From capital to RWA —** the output is K, the capital per euro of exposure. RWA is then K × 12.5 × EAD, where 12.5 is simply 1 ÷ 8%, so the familiar 8% rule still lands.

Why the Curve Bends

Because the model lets correlation fall as risk rises, a riskier borrower needs more capital — but less than you would expect.

CORPORATE · PD 1% · LGD 45% · M 2.5y

92%

the IRB risk weight of that loan — computed from the formula. The standardised approach would simply assign 100% to an unrated corporate.

The mechanism

Asset correlation R is not constant: Basel lets it fall from 0.24 to 0.12 as PD rises, because **very weak borrowers default for their own reasons more than the economy's**.
That flattens the curve.

Double the PD from 1% to 2% and the risk weight rises only from 92% to 115%: about a quarter more, not double.

Portfolio invariance has a price

The single-factor, fully-diversified assumptions are what let the regulator write one additive formula. The cost is that concentration risk (e.g. a portfolio built around a few large names) is not taken into account.
That gap is deliberate, and it is filled separately under Pillar 2.

KEY TAKEAWAY

The IRB risk weight is the output of a 99.9% one-year stress on a single shared factor: one PD in, one capital charge out. Not a number from a table.

This is Episode 11 of the Banking Metrics Series. Each episode takes one key metric that banks disclose under Basel III, breaks it down from first principles, and illustrates it with real data.