La Estadística y Mercados Financieros

Session III

Regulatory Models

Objetivo:

Conocer el entorno regulatorio de Modelos de riesgo de Crédito – Basel & IFRS 9

Agenda

What is IFRS9/Basel model?

What is the major change of IFRS9 reform from prior regulation?

How to do the IFRS9 modelling?

What is the major challenge for IFRS9 modelling?

What is the difference among IFRS9, Basel AIRB and stress testing?

Balance Sheet

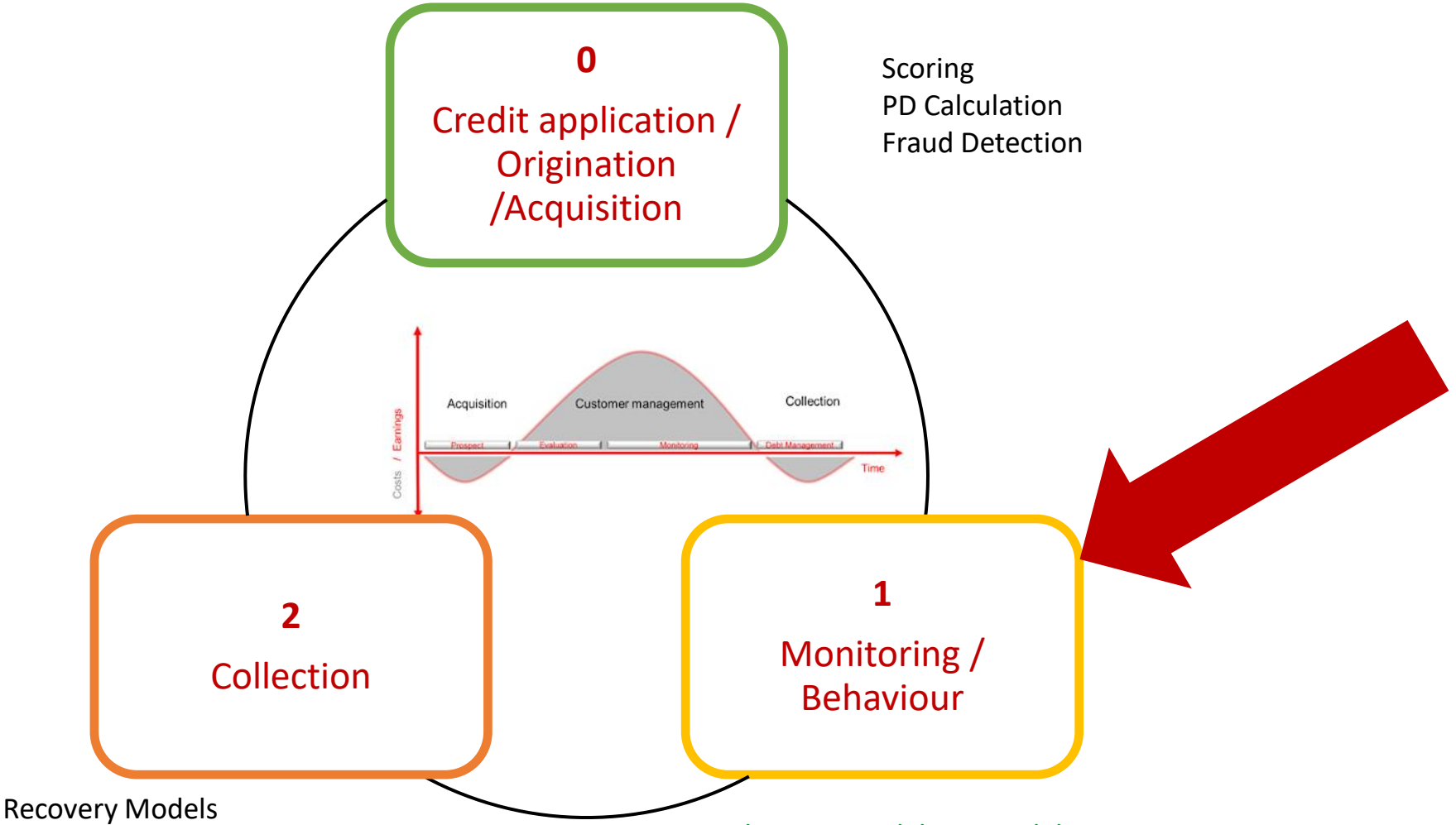
Concepto	Total Banca Múltiple
	202012
ACTIVO TOTAL	11,113,540
Disponibilidades e inversiones en valores	3,913,280
Cartera Total	5,161,426
Cartera Vigente	5,041,383
Comercial	3,325,241
Consumo	754,571
Vivienda	961,571
Cartera Vencida	120,043
Comercial	47,513
Consumo	39,260
Vivienda	33,270
Estimación de reservas	*-181,788*
Otros activos	2,220,622
PASIVO TOTAL	9,926,020
Captación Tradicional	6,248,460
Préstamos Interbancarios	350,668
Otros pasivos	3,326,892
CAPITAL CONTABLE	1,187,520
IMOR total (%)	2.33
IMOR comercial	1.41
IMOR consumo	4.95
IMOR vivienda	3.34

Income Statement

Concepto	Total Banca Múltiple 202012	
	Año en Curso	Mes en Curso
Ingresos por intereses	827,453	62,913
Gastos por intereses	313,037	20,612
Margen financiero	514,415	42,301
Estimación preventiva para riesgos crediticios	**157,636**	**14,482**
Margen financiero ajustado por riesgos crediticios	356,779	27,819
Comisiones netas	95,068	9,248
Gastos de administración y promoción	388,937	37,238
Resultado del negocio tradicional	62,910	-171
Resultado por intermediacion	38,610	3,736
Otros ingresos netos	918	956
Resultado neto	*102,438*	*4,521*

Source: CNBV Mexico SERIES HISTÓRICAS (AJUSTADAS PARA EFECTOS DE ANÁLISIS) Y CALIFICACIONES CREDITICIAS DE BANCOS / https://www.cnbv.gob.mx/Paginas/PortafolioDeInformacion.aspx
Montos en millones de pesos

Credit Lifecycle



What is Basel?

The Basel Committee - initially named the Committee on Banking Regulations and Supervisory Practices - was established by the central bank Governors of the Group of Ten countries at the end of 1974 in the aftermath of serious disturbances in international currency and banking markets….

Basel I is a set of international banking regulations put forth by the Basel Committee on Bank Supervision (BCBS) that sets out the minimum capital requirements of financial institutions with the goal of minimizing credit risk

Basel II has three pillars: minimum capital, supervisory review process, and market discipline Disclosure.

Basel III framework prescribes more of common equity, creation of capital buffer, introduction of Leverage Ratio, Introduction of Liquidity coverage Ratio(LCR) and Net Stable Funding Ratio (NSFR)

**https://www.bis.org/bcbs/history.htm*

What is IFRS 9?

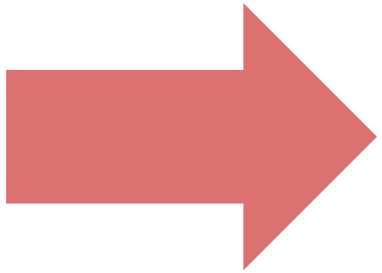
IFRS9 is the International Financial Reporting Standards for Financial Instruments that replace IAS 39 Financial Instruments: Recognition and Measurements for accounting periods beginning on or after 1 January 2018.

IFRS9 consists in three key components:

- ✓ Classification and measurement of financial instruments
- ✓ Impairment of financial assets
- ✓ Hedge accounting

IAS 39

Incurred loss acounting model, under the premise that all loans will be paid until a loss triggering event occurs. At that time the loan is considered impaired and its value is adjusted downwards



IFRS9

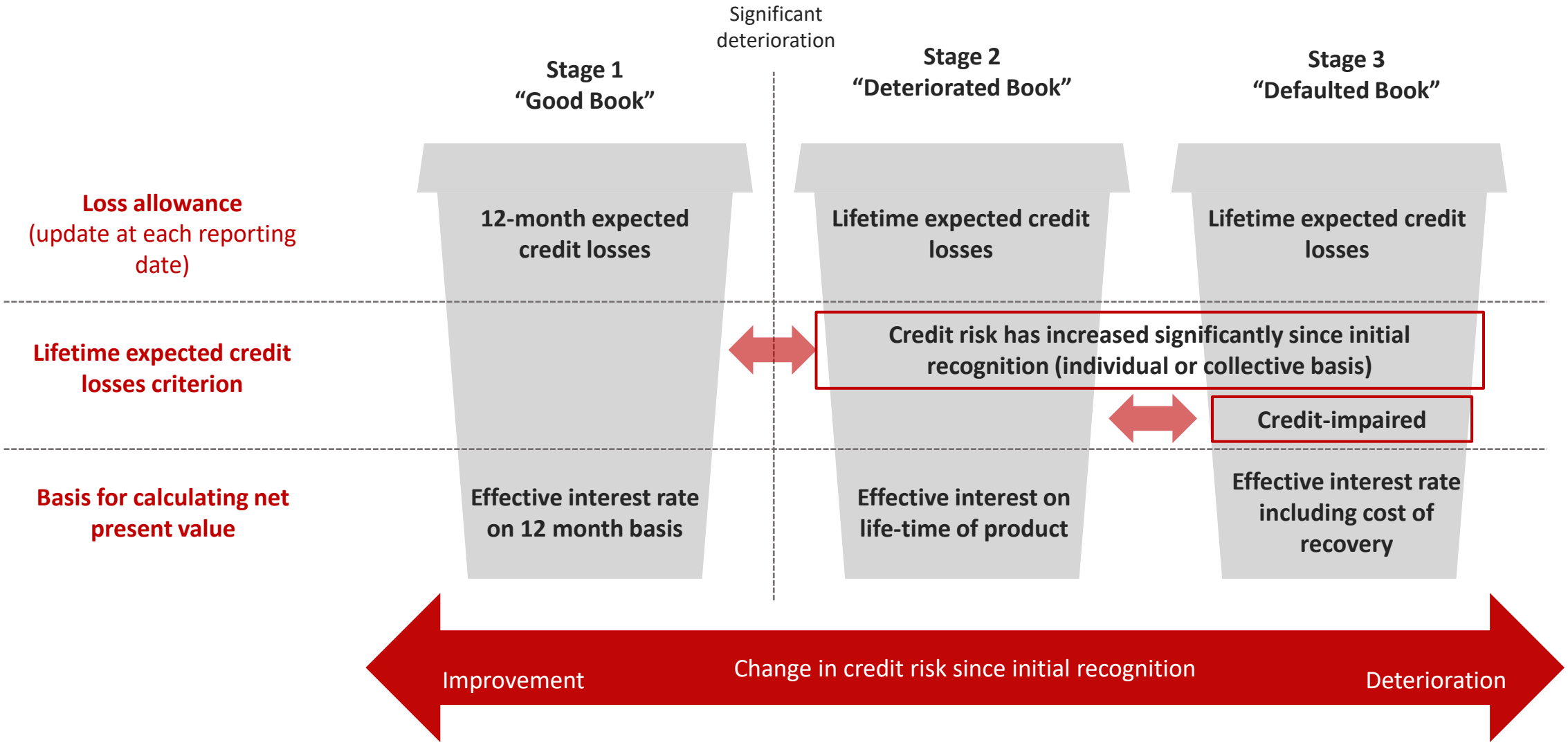
Expected Credit Loss accounting model, under the premise that the expected losses are recognized over the life of the financial asset, measured at amortized cost, and not until a loss event has been incurred

What is the major change of IFRS9 reform from prior regulation?

Following 2008 financial crisis, regulatros wanted to ensure that banks adopted a more conservative approach to provisioning.

IAS 39 **(**Consider losses arising from past events and current conditions**)**	**IFRS 9** **(**Forward-looking with historical, current, and forecasted data**)**
Collective impairment method with no apparently incurred loss	**Stage 1** Not deteriorated significantly in credit quality since initial recognition *12-month expected losses recognized*
	Stage 2 Deteriorated significantly in credit quality since initial recognition *Lifetime expected losses recognized*
Incurred loss event	Stage 3 Meets the current incurred loss definition on impaired at initial recognition Lifetime expected losses recognized

How to do the IFRS9 modelling? – Impairment Model



How to do the IFRS9 modelling? – Main Drivers of ECL

- Calculate Impairments = Expected Credit Loss (ECL)

$$Total\ EL = \sum_{i}^{n} PD_i * LGD_i * EAD_i$$

- Components
  - Exposure at Default (EAD) – gross value that a bank is exposed to at the time of a loan's default
  - Probability of Default (PD) – estimate of the likelihood that a borrower will be unable to meet its debt obligations
  - Loss Given Default (LGD) – is the amount of money a bank or other financial institutions loses when a borrower defaults a loan

Principles:

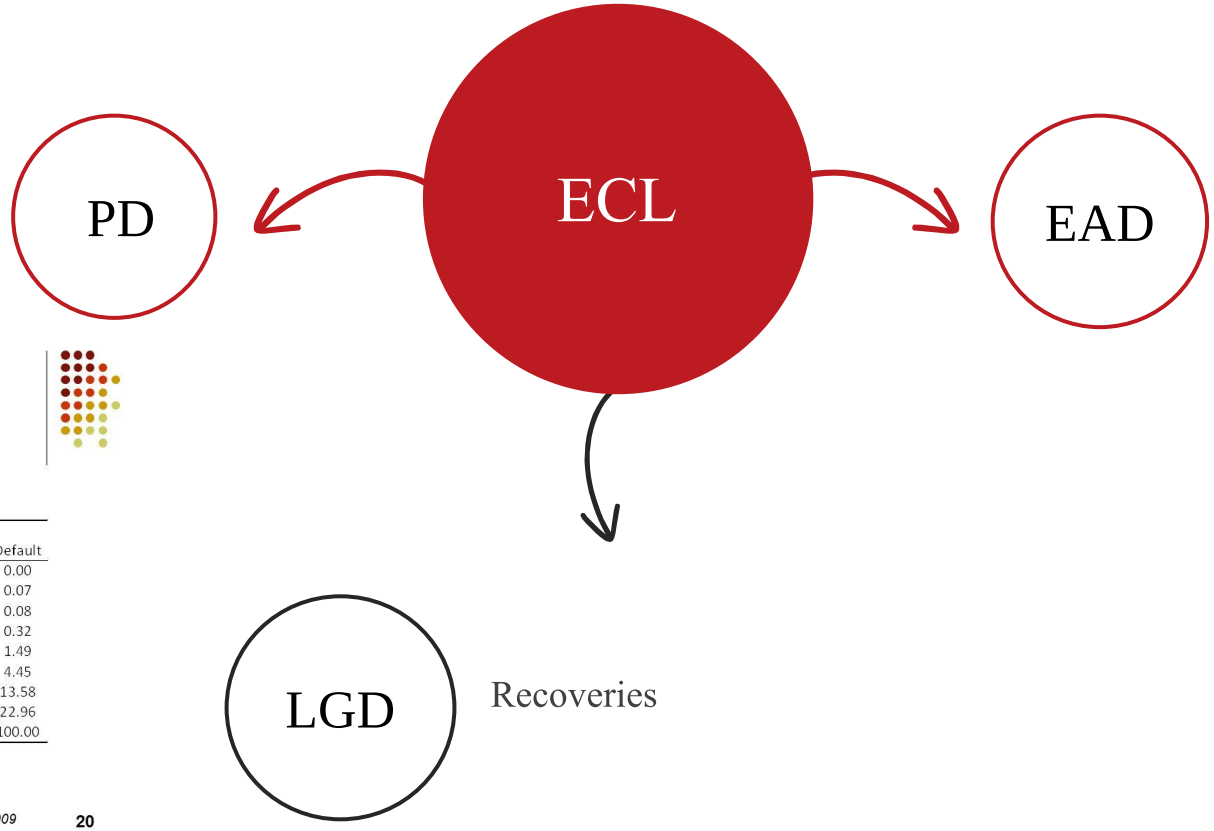
- Consider all relevant information
- Reflect current economic condition
- Include forward-looking economic forecast and bank expectations over customer

	Status of existing checking account	Duration in month	Credit history	Purpose	Credit amount	Savings account/bonds	Present employment since	Installment rate in percentage of disposable income	Personal status a
1	< 0 DM	6.0	A34	radio/television	1169.0	Unknown	... >=7 year	4.0	male: single
2	0 <... <200 DM	48.0	A32	radio/television	5951.0	... < 100 DM	1<= ... <4 years	2.0	female: divorced/separat
3	No	12.0	A34	education	2096.0	NaN	4<= ... <7 years	2.0	male: single
4	< 0 DM	42.0	A32	furniture/equipment	7882.0	... < 100 DM	4<= ... <7 years	2.0	male: single
5	< 0 DM	24.0	A33	New car	4870.0	... < 100 DM	1<= ... <4 years	3.0	NaN

Credit Card
Loan
Mortgage

LGD

Model the recovery rate



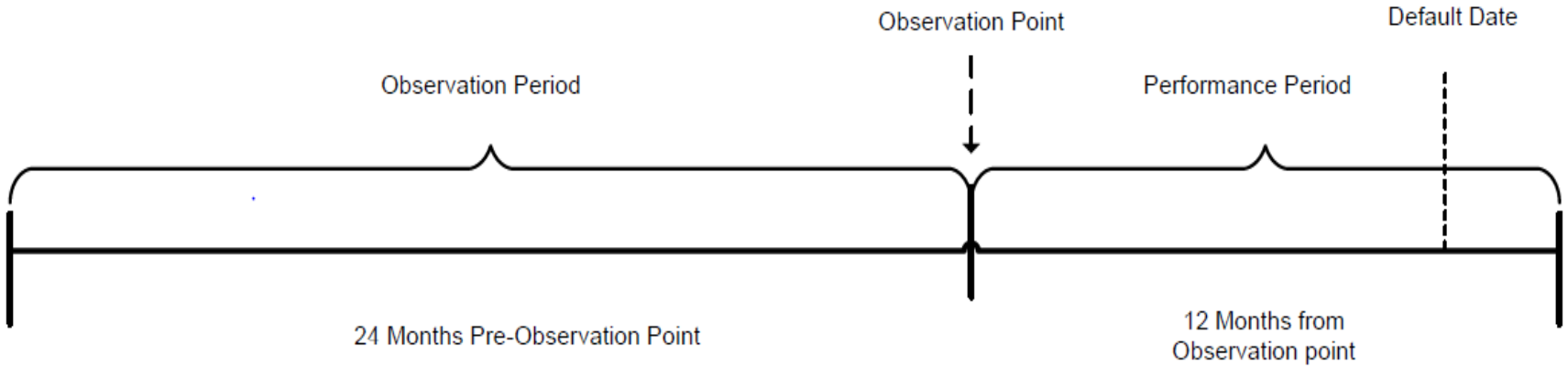
Certificates of Deposit
Bankers Acceptances
Repos
Long-term Debt

Rating Transition Matrix (% probability, Moody's 1970-2007)

Initial Rating	Rating at year end								
	Aaa	Aa	A	Baa	Ba	B	Caa	Ca-C	Default
Aaa	91.37	7.59	0.85	0.17	0.02	0.00	0.00	0.00	0.00
Aa	1.29	90.84	6.85	0.73	0.19	0.04	0.00	0.00	0.07
A	0.09	3.10	90.23	5.62	0.74	0.11	0.02	0.01	0.08
Baa	0.05	0.34	4.94	87.79	5.54	0.84	0.17	0.02	0.32
Ba	0.01	0.09	0.54	6.62	82.76	7.80	0.63	0.06	1.49
B	0.01	0.06	0.20	0.73	7.10	81.24	5.64	0.57	4.45
Caa	0.00	0.03	0.04	0.24	1.04	9.59	71.50	3.97	13.58
Ca-C	0.00	0.00	0.14	0.00	0.55	3.76	8.41	64.19	22.96
Default	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00

 20

Timeframes for PD12 Calculation



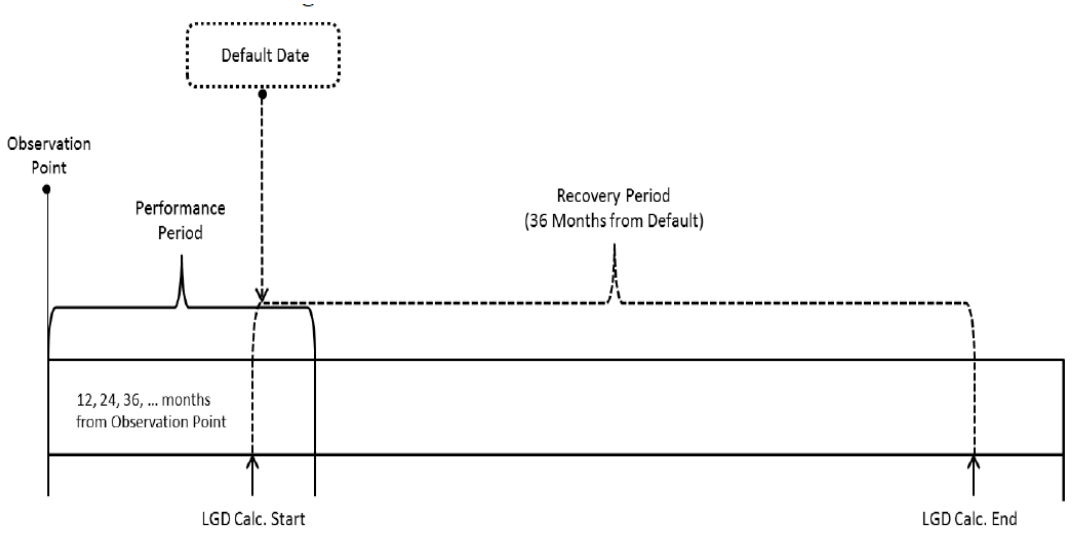
$$PD_{12} = 1 - \left(\frac{Odds_{PD12}}{1 + Odds_{PD12}}\right)$$

Where,

$Odds_{PD12}$ – odds of default occurring in the next 12 months which is calculated as

$$Odds_{PD12} = Odds_{standard} * 2\left(\frac{Score_{aligned} - Score_{standard}}{PDO}\right)$$

Timeframes for LGD12 Calculation



$$LGD_{12_i} = \frac{B_{def,i} - \sum_{t=def}^{def+36} NPV(R_{t,i}) + \sum_{t=def}^{def+36} NPV(DC_{t,i})}{B_{def,i}}$$

Where,

$B_{def,i}$ – Balance at the time of default for account i. If an account defaults more than once in the 12 month performance window (defaults, cures, and then defaults again), only the last default is considered in the LGD calculation.

$R_{t,i}$ – Recoveries for account i at time t,

$NPV(R_{t,i})$ – Net Present Value (NPV) of recoveries,

$NPV(DC_{t,i})$ – Net Present Value of direct costs which is calculated as:

$$NPV(DC_{t,i}) = \frac{DC_{t,i}}{(1 + DiscountRate)^{t/12}}$$

Where t is the month in which cost is allocated for account i.

The following formula is used to compute the segment-level LGD rate at time t:

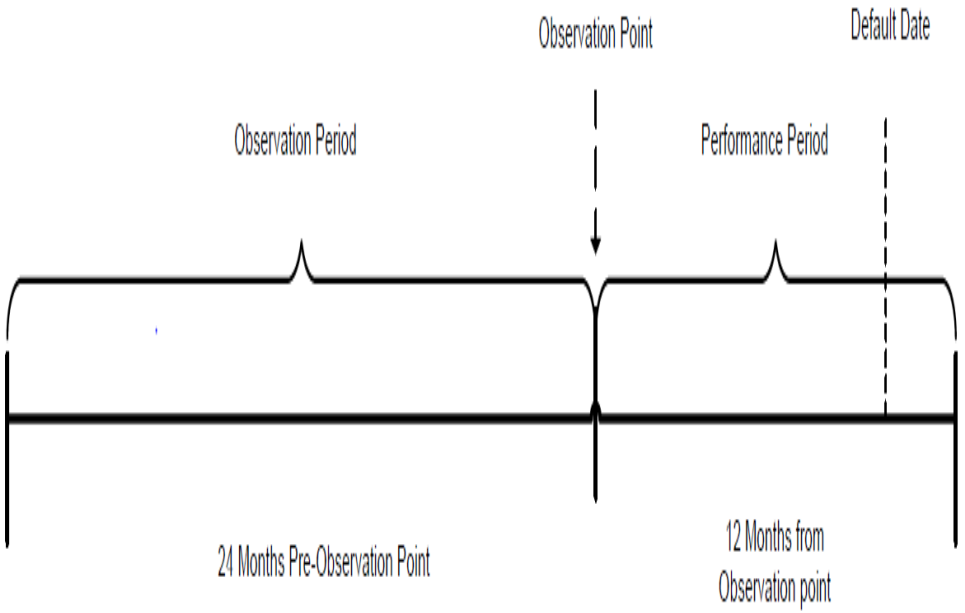
$$LGD_{12_{t,s}} = \frac{\sum_{i=1}^{ND_{t,s}} LGD_{cost_{t,s,i}}}{ND_{t,s}}$$

Where,

$ND_{t,s}$ – Number of defaults for segment s at time t,

$LGD_{12_{t,s}}$ - LGD with direct costs for account i belonging to segment s at time t

Timeframes for EAD12 Calculation



$$EAD_{12,i} = \frac{B_{def,i}}{\max(B_{obs,i}, L_{obs,i})}$$

Where,

$B_{def,i}$ – Balance at the time of default for account i. If an account defaults more than once in the 12 month performance window (defaults, cures, and then defaults again), only the last default is considered in the EAD calculation.

$B_{obs,i}$ – Balance at the time of observation for account i,

$L_{obs,i}$ – Limit at the time of observation for account i.

The segment-level realized EAD for revolving portfolios at time t is calculated as follows:

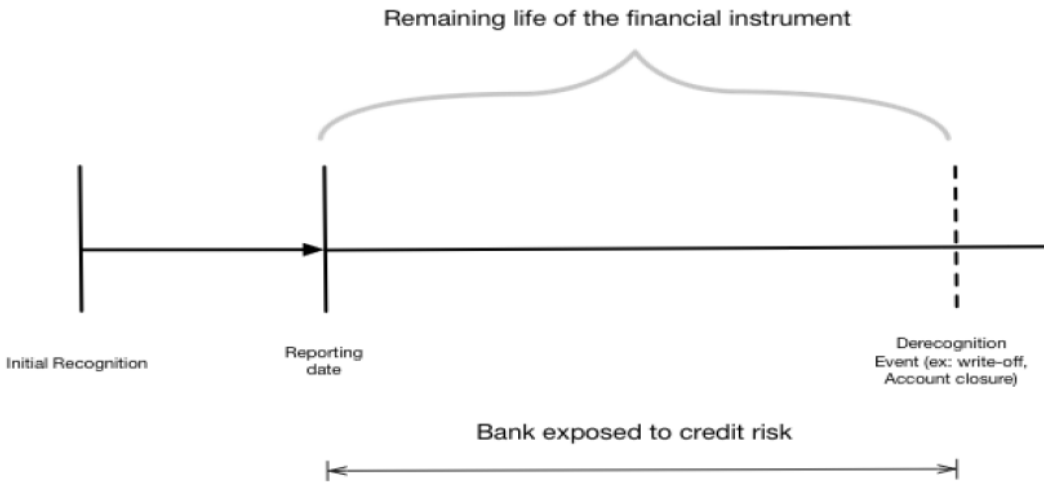
$$EAD_{12,t,s} = \frac{\sum_{i=1}^{ND_{t,s}} EAD_{12,t,s,i}}{ND_{t,s}}$$

Where,

$ND_{t,s}$ – Number of defaults for segment s at time t,

$EAD_{12,t,s}$ – EAD rate for account i belonging to segment s at time t.

The Expected Remaining Life (ERL) of financial instrument is defined in the IFRS 9 standard as the period over which the Bank is expected to be exposed to credit risk



$$ERL = P(TE)E[RL|TE] + \big(1 - P(TE)\big)E[RL|TE']$$

Where,

ERL – Expected Remaining Lifetime for each PD segment

P(TE) – Probability of a Terminal Event. This is the unconditional probability that an account could experience a terminal event at any point in its remaining contractual life from the reporting date. To calculate this probability, a cumulative terminal event (pre-payment or charge-off) curve is derived for the duration of the average remaining contractual life of each PD segment. P(TE) can then be expressed as:

$$P(TE) = P(TE_{RCL})$$

Where $P(TE_{RCL})$ is the probability of a terminal event at the level at which the terminal event curve reaches upon contractual maturity.

$E[RL|TE]$: Expected Remaining Lifetime given a terminal event. This represents the average time to prepayment or last default before a write-off event of accounts which experience a terminal event. $E[RL|TE]$ can be expressed as:

$$E[RL|TE] = \sum_{t=1}^{LT} P(TE_t)_{marginal} \times t$$

Which is the area under the survival curve. Each point in the survival curve represents the marginal probability that an account could experience a terminal event at that point conditional on the fact that it did not experience a terminal event before.

$\big(1 - P(TE)\big)$: The probability that an account will pay according to the original contractual terms, i.e., experiences no terminal event.

$E[RL|TE']$: Expected lifetime given no terminal event. This is calculated as the average remaining contractual life for the given segment.

IFRS 9 defines Lifetime Expected Credit Losses (LEL) as the "expected credit losses that result from all possible default events over the expected life of a financial instrument"

$$LEL = ECL_{12} + \sum_{k=13}^{LT} v^k (PDL_k) * (LGDL_k) * \max(limit, os\ balance) * (EADL_k)$$

Where,

ECL_{12} – 12-month ECL, as described in Section 2.1.2;

v^k – Discount factor for period k;

PDL_k – Probability of default within period k;

$LGDL_k$ – Loss given default for non-defaulted accounts over their lifetime if they default in period k;

$EADL_k$ – Exposure at default for an account that defaults in period k;

LT – Expected remaining lifetime of the account;

Limit – Credit limit at the time of observation;

OS Balance – Outstanding balance at the time of observation.

Logistic regression and Decision Tree – Classification And Regression Tree

The Decision Trees are built using the Classification And Regression Tree (CART) Algorithm. The algorithm is used to construct non-binary decision trees, where information gain is used to determine optimal splits.

PD and EAD segmentation are developing on Python, using Scikit-learn library, more specifically, the function DecisionTreeClassifier for PD and DecisionTreeRegressor for EAD.

Accuracy Ratio (PD/LGD/EAD)

The Accuracy Ratio (AR) is based on cumulative frequency curves that are used to compare the distribution of realized values of PD/EAD/LGD with a random distribution of default rates/EAD/LGD.

Wilcoxon Two-Sample Test (Mann Whitney U test)

The Wilcoxon two-sample non-parametric test provides an answer to the question of whether two samples originate from the same distribution. This approach is used for comparing two samples that are independent, or not related.

Z-Test

The binomial approximation of the z-test is used to compare proportions from two independent samples. For PD segmentation, the z-test is used to compare the proportion of defaulted accounts in adjoining segments (heterogeneity test) and to compare the proportion of defaulted accounts across the development and validation samples (homogeneity test).

Survival analysis (Kaplan–Meier curves & Survival function)
Bank estimates the expected remaining lifetime of a financial instrument based on historical data

Machine learning and artificial intelligence !!! Under progress!!

What is the major challenge for IFRS9 modelling?

Missing, inconsistent and or incorrect data → No explicit definition between stages

	Stage 1	Stage 2	Stage 3
Trigger	Initial recognition	Significant increase in credit risk	Credit-Impaired
ECL Time Horizon	12 month	Lifetime	Lifetime
Effective Interest Rate (EIR)	EIR on Gross Carrying amount (w/o ECL)	EIR on Gross Carrying amount (w/o ECL)	EIR on Amortised cost (with ECL)

Macroeconomic predictions and macroeconomic variable selection to become forward looking

Time value of money

Model validation as benchmark and back test. → ***Hard to implement machine learning!!!!!!***

What is the difference among IFRS9, Basel AIRB and stress testing?

IFRS 9

- Accounting standard for financial instruments
- Point-in-time estimate
- 12-month PD for Stage 1 and lifetime PD for stage 2 and 3
- Forward-looking assessment of past, current and expected future conditions

Base AIRB

- Advanced internal rating-based, credit risk measurement approach.
- Through-the-cycle assumptions; historical long-run average estimation
- 12-month PD
- Historical long-run average estimation

Stress testing

- Simulation to analyze the impact on bank's portfolio in drastic economic scenarios
- Builds on the framework of IFRS9
- Extreme but plausible scenarios

What is the difference among IFRS9, Basel AIRB and stress testing?

	IFRS 9	AIRB	Stress Testing
Purpose	Better accounting guidance to manage credit risk than IAS39	Risk Management tool to measure credit risk	Ensure Bank remain solvent in drastic economic conditions
Published by	IASB	Basel Committee	Basel Committee
Time Horizon	12 months/ Life Time	12 months	2 – 3 years 4 – 5 years
Model	ECL = PD*LGD*EAD	RWA =f(PD,LGD,EAD,…) Required Capital = 10.5% * RWA	KPIs = f(PD, LGD,EAD, Stressed Macro Factors)

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