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UK IRB Mortgages Round Table

Agenda

Topic
Opening
UK IRB Mortgage Thematic <ul style="list-style-type: none">• Background• Definition of Default• Q&A
UK IRB Mortgage Thematic <ul style="list-style-type: none">• PD models• Q&A
Break
UK IRB Mortgage Thematic <ul style="list-style-type: none">• LGD models• Q&A
UK IRB Mortgage Thematic <ul style="list-style-type: none">• Model Monitoring• Q&A
Closing and Next Steps



Background



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Background

In 2017, the PRA has completed a cross-firm review of UK Mortgage IRB models focusing primarily on Probability of Default (PD) and Loss Given Default (LGD) models

Objectives

- The main objectives of this cross firm review were to:
 - Improve the PRA's understanding of cross-industry modelling approaches and model performance
 - Identify areas of non-compliance with regulatory requirements and PRA's expectations
 - Identify modelling choices that could be leading to unwarranted variability of final model estimates

Findings

- Model weaknesses have been identified across several firms in the following areas:
 - Definition of Default
 - Probability of Default Model
 - Loss Given Default Model
 - Model Monitoring
- **The main purpose this material is to communicate these cross-firm weaknesses identified and clarify the PRA's expectations in these areas**



Definition of Default



Definition of Default

Areas of Weakness

Finding Description	Risk
<ul style="list-style-type: none">Lack of consistency in the Definition of Default (DoD) used across PD and LGD models, due to different cure definitions being used	<ul style="list-style-type: none">The use of different cure definitions to model PD and LGD estimates could result in the underestimation of model parameters and, consequently, in the underestimation of capital requirements
<ul style="list-style-type: none">Lack of analysis supporting the treatment of Unlikelihood to Pay (UTP) criteria, including forbearance treatment, within the definition of default	<ul style="list-style-type: none">UTP indicators capture increases in customer risk where customer arrears have not started accumulating yetThe failure to identify default events could result in the underestimation of model parameters and, consequently, in the underestimation of capital requirements



Definition of Default

Capital Requirements Regulation

- **CRR art 175 3:** *The institutions shall document the specific definitions of default and loss used internally and ensure **consistency with the definitions** set out in this Regulation.(.)*
- **CRR art 178 1:** *A default shall be considered to have occurred with regard to a particular obligor when either or both of the following have taken place:
 - (a) *the institution considers that the obligor is unlikely to pay its credit obligations to the institution, the parent undertaking or any of its subsidiaries in full, without recourse by the institution to actions such as realising security;*
 - (b) *the obligor is **past due more than 90 days** on any material credit obligation to the institution, the parent undertaking or any of its subsidiaries. Competent authorities may replace the 90 days with 180 days for exposures secured by residential or SME commercial real estate in the retail exposure class, as well as exposures to public sector entities).**
- **CRR art 178 3:** *For the purpose of point (a) of paragraph 1, elements to be taken as indications of **unlikeliness to pay** shall include the following:
 - (a) *the institution puts the credit obligation on non-accrued status;*
 - (b) *the institution recognises a specific credit adjustment resulting from a significant perceived decline in credit quality subsequent to the institution taking on the exposure;*
 - (c) *the institution sells the credit obligation at a material credit- related economic loss;*
 - (d) *the institution consents to a distressed restructuring of the credit obligation (...)*
 - (e) *the institution has filed for the obligor's bankruptcy or a similar order in respect of an obligor's credit obligation to the institution, the parent undertaking or any of its subsidiaries;*
 - (f) *the obligor has sought or has been placed in bankruptcy or similar protection where this would avoid or delay repayment of a credit obligation to the institution, the parent undertaking or any of its subsidiaries.**

Bold, underlined text indicates PRA emphasis added



Definition of Default

Supervisory Statement 11/13

- **SS11/13 paragraph 11.5:** *The PRA expects that a credit obligation be considered a **distressed restructuring** if an independent third party, with expertise in the relevant area, would not be prepared to provide financing on substantially the same terms and conditions.*
- **SS11/13 paragraph 11.6:** *In order to be satisfied that a firm complies with the documentation requirements set 11.6 out in CRR Article 175(3) the PRA expects that a firm should have a **clear and documented policy** for determining whether an exposure that has been in default should subsequently be returned to performing status.*
- **SS11/13 paragraph 13.5:** *Where firms wish to include cures in their LGD estimates, the PRA expects them to do so **on a cautious basis** with reference to both their current experience and how this is expected to change in downturn conditions. In particular, this involves being able to articulate clearly both the precise course of events that will allow such cures to take place and any consequences of such actions for other elements of their risk quantification. For example:
 - (a) *where cures are driven by the firm's own policies, we would expect firms to consider whether this is likely to result in **longer realisation periods** and larger forced sale discounts for those exposures that do not cure, and higher default rates on the book as a whole, relative to those that might be expected to result from a less accommodating attitude. To the extent feasible, the PRA expects cure assumptions in a downturn to be supported by relevant historical data.*
 - (b) *the PRA expects firms to be aware of and properly account for **the link between cures and subsequent defaults**. In particular, an earlier cure definition is, other things being equal, likely to result in a higher level of subsequent defaults.**



Definition of Default

Overview of expectations

Definition component	Expectations
Days past due	<ul style="list-style-type: none"> • A back-stop of 90 or 180 days past due must be defined • Consideration should be given to mortgage exposures reaching their maturity date and how the number of days past due is being calculated past maturity
Unlikelihood to pay indicators	<ul style="list-style-type: none"> • Firms should undertake robust analysis to support the treatment of all potential Unlikelihood to Pay (UTP) criteria within the default definition. Examples include: <ul style="list-style-type: none"> ○ Bankruptcy ○ Litigation / possession ○ Forbearance ○ Specific provision raised • Consideration should be given to the measurement of subsequent arrears emergence for all UTP events (e.g. is a forbearance delaying a default event or is it leading to a cure?) • The firm should be able to demonstrate the models' accuracy on relevant UTP sub-segments (e.g. forbearance)
Cure definition (i.e. the criteria used to return defaulted mortgages to a performing status)	<ul style="list-style-type: none"> • A cure definition must be defined and its incorporation in final model estimates should be done on a cautious basis • Firms should undertake robust analysis to support their definition of cure • Consideration should be given to the measurement of cures against subsequent arrears emergence • Consideration should be given to the impact of long cure periods on key model parameters (example: possession rates and unresolved accounts)
Consistency across PD and LGD	<ul style="list-style-type: none"> • The definition of default must be consistent across PD, LGD and EAD model parameters • Consideration should be given to cure periods and the alignment with the 12 month performance window used to model PD estimates
Documentation	<ul style="list-style-type: none"> • Firms should have a clear and documented policy describing their default definition and in which circumstances an exposure that has been in default should subsequently be returned to performing status



Definition of Default

Example – Treatment of Forbearance

- The PRA recognises that firms may choose to treat forborne accounts differently according to its internal experience and risk management practices
- However, regardless of which approach is chosen, the PRA expects firms to be able to demonstrate its appropriateness through robust analysis
- In particular, as a minimum, consideration should be given to the following:
 - a. the type of forbearance;
 - b. the measurement of subsequent arrears emergence – ***is a forbearance resulting in a cure or is it creating a lag effect in customers' arrears?***; and
 - c. accuracy of parameter estimates on the forbearance segment – ***are PD and LGD model estimates appropriate for forbearance?***



Definition of Default

Consistency between PD and LGD estimates

- The definition of default must be consistent across PD and LGD model parameters
- Consideration should be given to **cure periods** (i.e. the period where accounts remain in default, although the account has returned to a performing stage) and the alignment with the **12 month performance window** used to model PD estimates
- The cure definition has a material impact in the estimation of possession rates since it can artificially lower it by increasing the volume of re-defaults
- The formula below mathematically articulates the calculation of Possession Rates:

$$Possession\ rate_t = \frac{Volume\ of\ Defaults\ at\ time\ t\ that\ went\ into\ possession}{Volume\ of\ Defaults_t}$$

Cure definition assumptions	Impact on Default accounts that subsequently cure	Impact on Possession rates
Long cure periods	<p><u>Long cure</u> periods will result in :</p> <ul style="list-style-type: none"> • Decreasing cure observations following default • Decreasing re-default events following cure 	<ul style="list-style-type: none"> • The volume of possessions is not affected • The volume of defaults decreases (denominator) • Longer 'time from default to possession' periods
Short cure periods	<p><u>Short cure</u> periods will result in :</p> <ul style="list-style-type: none"> • Increasing cure observations following default • Increasing re-default events following cure 	<ul style="list-style-type: none"> • The volume of possessions is not affected • The volume of defaults increases (denominator) • The possession rate (artificially) decreases, although the volume of possessions remains unchanged • Shorter 'time from default to possession' periods



Probability of Default



Probability of Default

Areas of weakness

Finding Description	Risk
<ul style="list-style-type: none">Lack of risk differentiation in regulatory PD estimates for pipeline and new lending	<ul style="list-style-type: none">Capital requirements will remain static regardless of the level of new lending's underlying riskCapital requirements will not reflect changes in underwriting standards and risk appetiteCapital requirements may be underestimated
<ul style="list-style-type: none">Insufficient link between capital requirements and the credit approval process (Use test)	
<ul style="list-style-type: none">Inconsistency in the interpretation of the objectives of Point-in-Time PD buffers	<ul style="list-style-type: none">PD estimates do not adequately capture significant movements in default rates and therefore capital requirements are underestimated
<ul style="list-style-type: none">The extent to which Point-in-Time PD Buffer estimates are conservative	



Probability of Default

New lending and pipeline business – Capital Requirements Regulation

- **CRR art 141 1. (a) & (b):** *The competent authority shall grant permission pursuant to Article 143 for an institution to use the IRB Approach, including to use own estimates of LGD and conversion factors, only if the competent authority is satisfied that requirements laid down in this Chapter are met, in particular those laid down in Section 6, and that the systems of the institution for the management and rating of credit risk exposures are sound and implemented with integrity and, in particular, that the institution has demonstrated to the satisfaction of the competent authority that the following standards are met:*
 - (a) the institution's rating systems provide for a meaningful assessment of obligor and transaction characteristics, a meaningful differentiation of risk and **accurate and consistent quantitative estimates of risk**;*
 - (b) internal ratings and default and loss estimates used in the calculation of own funds requirements and associated systems and processes play an essential role in the **risk management and decision-making process**, and in the **credit approval**, internal capital allocation and corporate governance functions of the institution;*
- **CRR art 170 3.(a) (b):.** *The structure of rating systems for retail exposures shall comply with the following requirements:*
 - (a) rating systems shall reflect both obligor and transaction risk, and shall capture all **relevant obligor and transaction characteristics**;*
 - (b) the level of **risk differentiation** shall ensure that the number of exposures in a given grade or pool is sufficient to allow for meaningful quantification and validation of the loss characteristics at the grade or pool level. The distribution of exposures and obligors across grades or pools shall be such as to avoid excessive concentrations;*



Probability of Default

New lending and pipeline business – Overview of PRA Expectations

Area	Expectations
Pipeline business and New lending regulatory PD estimates	<ul style="list-style-type: none">• The PRA expects PD models to provide for:<ul style="list-style-type: none">a) a meaningful assessment of obligor and transaction characteristics;b) a meaningful differentiation of risk; andc) accurate and consistent quantitative estimates of risk across time, including for new accounts on book
Use test	<ul style="list-style-type: none">• The PRA considers the direct link between the application scorecards (or application data used for underwriting new business) and its IRB PD models to be an important part of the use test requirement
Transition between application and behavioural scorecards	<ul style="list-style-type: none">• Consideration should be given to the transition between application and behavioural scorecards for the purpose of estimating final PDs and the extent to which the final approach results in accurate estimates

What if there aren't enough defaults for new lending and pipeline business?

- The PRA recognises that the low volume of CRR defaults for new lending and pipeline business creates additional challenges for firms to meet these expectations
- Therefore, consideration should be given to
 - the use of alternative measures of default (i.e. 'bad definitions')
 - the use of a margin of conservatism to mitigate the low volume of data

- ✓ It is fundamental that firms have in place a rating system structure that would ensure risk differentiation and appropriate regulatory capital allocation **across time**
- ✓ This will ensure capital requirements will be aligned with the portfolio's risk profile and reflect changes in risk appetite



Probability of Default

Point-in-Time buffers – Capital Requirements Regulation & SS11/13

- **CRR art 179 1 (a) (d) (f):** *In quantifying the risk parameters to be associated with rating grades or pools, institutions shall apply the following requirements:*
 - (a) *an institution's own estimates of the risk parameters PD, LGD, conversion factor and EL shall incorporate all relevant data, information and methods. The estimates shall be derived using both historical experience and empirical evidence, and not based purely on judgemental considerations. The estimates shall be plausible and intuitive and shall be based on the material drivers of the respective risk parameters. **The less data an institution has, the more conservative it shall be in its estimation;***
 - (d) *the population of exposures represented in the data used for estimation, the lending standards used when the data was generated and other relevant characteristics shall be comparable with those of the institution's exposures and standards. The economic or market conditions that underlie the data shall be relevant to current and foreseeable conditions. The number of exposures in the sample and the data period used for quantification shall be sufficient to provide the institution with confidence in the **accuracy and robustness of its estimates;***
 - (f) *an institution shall add to its estimates a margin of conservatism that is related to the expected range of estimation errors. Where methods and data are considered to be less satisfactory, the expected range of errors is larger, the **margin of conservatism** shall be larger.*
- **SS11/13 paragraph 12.2:** *Most rating systems sit between these two extremes. Rating philosophy is determined by the cyclicity of the drivers/criteria used in the rating assessment, and should not be confused with the requirement for grade level PDs to be 'long run'. The calibration of even **the most PiT rating system needs to be targeted at the long-run default rates for its grades;** the use of long-run default rates does not convert such a system into one producing TTC ratings or PDs.*



Probability of Default

Point-in-Time buffers

Why do Point-in-Time models need to be re-calibrated?

- Point-in-Time models are dynamically recalibrated to ensure PD estimates are aligned to recent default rates

Why is a buffer required?

- We expect a buffer to be added to the PD estimates to reflect the risk that default rates may increase during the time taken to recalibrate, go through governance and implement

What should be the size of buffer?

- The size of the buffer should be based on the time taken by the firm to recalibrate
- Consideration should be given to all historical data, which should include periods of increasing default rates

The PRA expects firms to have Point-in-Time PD buffers in order to:

- ✓ Capture the risk of the default rates increasing between calibrations
- ✓ Mitigate for underestimation due to PiT PD estimates deviating from recent observed default rates, as they may have already changed from those used in the last calibration



Probability of Default

Point-in-Time buffers Principles

Principle	Expectations
Objective	<ul style="list-style-type: none">The buffer is required to mitigate the risk of PD underestimation between Point-in-Time PD model calibrations. The PD buffer is not required to mitigate the model risk of PD underestimation through the 12 month PD outcome period
Design	<ul style="list-style-type: none">The design of the PD buffer and the values derived for the PD buffer should be made with consideration of the approach taken to PD model calibrations. Where more complex approaches to calibrations are used, such as triggers based on observed increases in default rates, we would always expect the PD buffer to be higher than the trigger
Data	<ul style="list-style-type: none">The PD buffer should be based on analysis of all available data. In addition, where firm's data only includes periods of decreasing default rates, we expect firms to consider whether this is sufficient to estimate a PD buffer that mitigates PD underestimation between calibrations during periods of increasing default rates
Sample	<ul style="list-style-type: none">Consideration should be given to the use of blended monthly samples used in model calibrations and the extent to which these may lead to underestimation in default rates
Use	<ul style="list-style-type: none">Where the PD buffer is being applied to a population not used in its development data, the firm needs to demonstrate the PD buffer methodology and values are appropriate.
Back testing	<ul style="list-style-type: none">Firms need to demonstrate how the model would have performed historically had the proposed approach for buffers and recalibrations been in place over the entire historic period
Accuracy	<ul style="list-style-type: none">We expect a firm to demonstrate how the PD buffer works going forward, in combination with the approach to calibrations

The PRA intends to consult in 2018 on an update to SS 11/13 to set out these expectations on Point in Time buffers.



Loss Given Default



Loss Given Default

Areas of weakness

Finding Description	Risk
<ul style="list-style-type: none"> Lack of segmentation of Probability of Possession Given Default models for material sub-portfolios 	<ul style="list-style-type: none"> Insufficient risk differentiation of loss estimates Underestimation of possession rates for key portfolio segments (e.g. exposures in default or BTL exposures) and, consequently, underestimation of capital requirements
<ul style="list-style-type: none"> Lack of segmentation of Forced Sale Discount models for material sub-portfolios 	<ul style="list-style-type: none"> Insufficient risk differentiation of loss estimates Underestimation of collateral haircuts for key portfolio segments (e.g. BTL exposures) and, consequently, underestimation of capital requirements
<ul style="list-style-type: none"> Inconsistency in the approaches used to estimate downturn possession rates 	<ul style="list-style-type: none"> An inappropriate choice of downturn calibration could lead to an underestimation of possession rates and, consequently, an underestimation of capital requirements
<ul style="list-style-type: none"> Lack of consideration of the impact of unresolved accounts (i.e. accounts that do not cure or get possessed within the outcome window) in the estimation of model components including 'Time to' parameters 	<ul style="list-style-type: none"> No consideration for the impact of unresolved accounts could lead to an inappropriate choice of outcome period and the underestimation of model components, e.g. possessions, collateral haircuts and 'time to' parameters The underestimation of model components could lead to the underestimation of losses and an underestimation of capital requirements



Loss Given Default

Capital Requirements Regulation & Supervisory Statement 11/13

- **CRR art 181 1 (b) (h):** *In quantifying the risk parameters to be associated with rating grades or pools, institutions shall apply the following requirements specific to own-LGD estimates:
(b) institutions shall use LGD estimates that are **appropriate for an economic downturn** if those are more conservative than the long-run average. To the extent a rating system is expected to deliver realised LGDs at a constant level by grade or pool over time, institutions shall make adjustments to their estimates of risk parameters by grade or pool to limit the capital impact of an economic downturn;
(h) for the specific case of **exposures already in default**, the institution shall use the sum of its best estimate of expected loss for each exposure given current economic circumstances and exposure status and its estimate of the increase of loss rate caused by possible additional unexpected losses during the recovery period, i.e. between date of default and final liquidation of the exposure;*
- **SS11/13 paragraph 13.6:** *In order to ensure that estimates of LGDs take into account the most up to date experience, we would expect firms to take account of data in respect of **relevant incomplete workouts** (ie defaulted exposures for which the recovery process is still in progress, with the result that the final realised losses in respect of those exposures are not yet certain).*
- **SS11/13 paragraph 13.10:** *In order to ensure that their LGD estimates are oriented towards **downturn conditions**, the PRA expects firms to have a process through which they:
(a) identify appropriate downturn conditions for each IRB exposure class within each jurisdiction;
(b) identify adverse dependencies, if any, between default rates and recovery rates; and
(c) incorporate adverse dependencies, if identified, between default rates and recovery rates in the firm's estimates of LGD in a manner that meets the requirements relating to an economic downturn.*
SS11/13 paragraph 13.13 *In addition to the above measures the PRA expects firms to ensure that no **discount rate** used to estimate LGD is less than 9%.*



Loss Given Default

Overview of Expectations - Probability of Possession Given Default Models

Area	Expectations
Model Segmentation	<ul style="list-style-type: none"> • Possession events are conditional on their time since default, therefore the PRA expects appropriate possession estimates for accounts not yet in default and those currently in default • The PRA would expect a possession model to take into account material drivers of risk and be segmented accordingly • Therefore, and as a minimum, firms should be able to demonstrate the accuracy of possession estimates by: <ul style="list-style-type: none"> ○ Loan-to-Value (LTV); and ○ mainstream versus other specialist mortgages, notably Buy-To-Lets • When enough data is available, consideration should be given to the development of bespoke models on key portfolio segments
Outcome period	<ul style="list-style-type: none"> • The PRA expects firms to use all available data to determine an appropriate outcome period to model possession estimates • The outcome period should be sufficiently long to capture all possessions and cures, and minimise the number of unresolved accounts.
Cure Definition	<ul style="list-style-type: none"> • The PRA expects firms to have a defined cure definition, i.e. in which circumstances an exposure that has been in default should subsequently be returned to a performing status
Unresolved accounts	<ul style="list-style-type: none"> • A key modelling assumption is that defaulted exposures will end up cured or possessed. However, even after a long outcome period, a small proportion of defaulted exposures could remain unresolved • The PRA expects firms to produce robust analysis in supporting the treatment of these unresolved exposures. The most conservative approach consists in classing all these exposures as a possession event
Downturn Calibration	<ul style="list-style-type: none"> • The PRA expects firms to analyse historic internal possession rates (potentially leading to a calibration based on the highest observed rates), and / or economic drivers, linking possession rate experience to a view on what constitutes an economic downturn • Firms should understand the impact of using different LTV measures (origination LTV, HPI LTV or downturn LTV) on the variability of final downturn possession estimates through the economic cycle • If a firm does not have enough data to support its choice of a downturn period, a margin of conservatism should be added to final model estimates



Loss Given Default

Overview of Expectations – Forced Sale Discount Models

Area	Expectations
Model Segmentation	<ul style="list-style-type: none">• The PRA expects firms to demonstrate the accuracy of collateral haircut estimates on key portfolio segments. Consideration should be given to:<ul style="list-style-type: none">○ mainstream versus other specialist mortgages, notably Buy-To-Lets○ property types• When using UK regions as a segmentation driver, consideration should be given to the impact of future downturns in each region since it could be different from previous recessions• When enough data is available, consideration should be given to the development of bespoke models on key portfolio segments
Downturn Calibration	<ul style="list-style-type: none">• The PRA expects firms to analyse historic internal sales values compared to estimates pre-default, with collateral haircuts calibrated to an economic downturn• If a firm does not have enough data to support its choice of a downturn period, a margin of conservatism should be added to final model estimates



Loss Given Default

Overview of Expectations – ‘Time to’ Parameters

Area	Expectations
Model Segmentation	<ul style="list-style-type: none">• The PRA expects firms to produce separate estimates for the period from default to possession (time to possession) and for the period from possession to sale (time to sale)• The PRA expects firms to demonstrate the accuracy of possession estimates on key portfolio segments. Consideration should be given to:<ul style="list-style-type: none">○ default and not in default exposures○ mainstream versus other specialist mortgages, notably Buy-To-Lets• When enough data is available, consideration should be given to the development of bespoke models on key portfolio segments
Unresolved accounts	<ul style="list-style-type: none">• Consideration should be given to the impact of unresolved accounts in final ‘time to’ estimates
Downturn Calibration	<ul style="list-style-type: none">• ‘Time to’ parameters should be based on downturn economic assumptions• The PRA expects firms to analyse historic internal possessions and sales with time to possession and time to sale calibrated to an economic downturn• If a firm does not have enough data to support its choice of a downturn period, a margin of conservatism should be added to final model estimates
Discount rate	<ul style="list-style-type: none">• The PRA expects firms to use a minimum 9% discount rate

Additionally

- The PRA expects a **5% account level** LGD floor. The PRA intends to consult in 2018 on an update to SS 11/13 to set out this expectation.



Model Monitoring



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Model Monitoring

Background

The PRA believes model monitoring to be an integral part of the rating system ongoing management process. Therefore, model monitoring management information (MI) packs should be complete and detailed enough to allow:

- a **good understanding of the rating system structure** by the credit risk control unit and senior management
- a **good understanding of model weaknesses and limitations** by the credit risk control unit and senior management
- the **assessment of model performance** at an overall level and for material or strategic portfolio risk drivers
- a **timely identification of model deterioration** and associated actions taken as a result

Key considerations:

- *Are all model components and assumptions being monitored?*
- *Are model monitoring conclusions and messages clearly identified and model risks outlined?*
- *What are the key metrics used to assess model performance?*
- *If the firm intends to increase its BTL market share, can it demonstrate that model estimates are appropriate for this segment?*
- *Are tolerances assigned to each metric?*
- *What actions have been identified to mitigate model deterioration in the event of tolerances being breached?*



Model Monitoring

Overview of Weakness

Finding Description	Risk
<ul style="list-style-type: none">Insufficient PD model monitoring for Variable Scalar and Hybrid modelling approaches	<ul style="list-style-type: none">Poor understanding of the weaknesses in the rating systemFailure to take mitigating actions in the event of model deteriorationThe Board (via its designated committee) does not have sight of the rating system performance.PD and LGD model estimates may no longer remain appropriate over time.PD and LGD model estimates are underestimated and, consequently, capital requirements are understated.
<ul style="list-style-type: none">Insufficient model monitoring for LGD models, in particular downturn components where observed recent losses are being compared with downturn estimates	



Model Monitoring

Capital Requirements Regulation

- **CRR art 185 (a), (b) & (e):** *Institutions shall validate their internal estimates subject to the following requirements:*
 - (a) *institutions shall have robust systems in place to validate the accuracy and consistency of rating systems, processes, and the estimation of all relevant risk parameters. The internal validation process shall enable the institution to assess the performance of internal rating and risk estimation systems consistently and meaningfully;*
 - (b) *institutions shall regularly **compare realised default rates with estimated PDs for each grade** and, where realised default rates are outside the expected range for that grade, institutions shall specifically analyse the reasons for the deviation. Institutions using own estimates **of LGDs and conversion factors shall also perform analogous analysis for these estimates.** (...)*
 - (e) *institutions shall have sound internal standards for situations where deviations in realised PDs, LGDs, conversion factors and total losses, where EL is used, from expectations, become significant enough to call the validity of the estimates into question. These standards shall take account of business cycles and similar systematic variability in default experience. **Where realised values continue to be higher than expected values,** institutions shall revise estimates upward to reflect their default and loss experience;”*
- **CRR art 188:** *Institutions shall have robust systems in place to validate the accuracy and consistency of their internal models and modelling processes. All material elements of the internal models and the modelling process and validation shall be documented.*
- **CRR art 189 2 & 3:** *Senior management shall be subject to the following requirements:*
 - (a) *they shall provide notice to the management body or a designated committee thereof of material changes or exceptions from established policies that will materially impact the operations of the institution's rating systems;*
 - (b) *they shall have a good understanding of the rating systems designs and operations;*
 - (c) *they shall ensure, on an ongoing basis **that the rating systems are operating properly.***

Senior management shall be regularly informed by the credit risk control units about the performance of the rating process, areas needing improvement, and the status of efforts to improve previously identified deficiencies.

3. *Internal ratings-based analysis of the institution's credit risk profile shall be **an essential part of the management reporting** to these parties. Reporting shall include at least risk profile by grade, migration across grades, estimation of the relevant parameters per grade, and comparison of realised default rates, and to the extent that own estimates are used of realised LGDs and realised conversion factors against expectations and stress-test results. Reporting frequencies shall depend on the significance and type of information and the level of the recipient.*



Model Monitoring

Supervisory Statement 11/13

- **SS11/13 paragraph 17.4:** *The PRA expects that a firm establishing compliance with CRR Article 185 for residential mortgage rating systems should be able to demonstrate that its monitoring includes at least the following:*
 - (a) *an assessment of whether each **long-run average PD remains appropriate** to the population it is applied to, including whether movements in default rate are due to external factors or changes in underlying credit quality. The PRA would expect to see consideration given to internal firm historical data, industry data and economic data in assessing this;*
 - (b) *an assessment of the **rating system's cyclicality**; and*
 - (c) *an assessment of the performance of any underlying **rank-ordering or segmentation** mechanism.*
- **SS11/13 paragraph 17.5** *When applying for permission for either a new residential mortgage PD rating system or a material change to an existing rating system, the PRA **expects firms to submit a completed monitoring management information pack** in support of their application.*
- **SS11/13 paragraph 18.19 (e):** *in relation to CRR Article 189(3), management information covering all aspects required by the CRR is produced and reviewed regularly by senior management and the **tolerances for the degree of divergence, and associated actions** for what should happen when they are not met, are pre-defined;*
- **SS11/13 paragraph 19.16:** *Firms should **address identified model issues in a timely fashion** with suitable model changes, and ensure that such changes are implemented in accordance with the appropriate model changes process. The PRA recognises, however, that there are instances where it is prudent and correct for firms to adjust the capital requirements produced by their models on a temporary basis. The PRA does not expect any such adjustment to be in place for a period longer than six months and firms should take any action required to remove an adjustment (including notifying the PRA of a model change where appropriate) within that period.*



Model Monitoring

Overview of Expectations

Area	Expectations
Scope	<ul style="list-style-type: none">• The PRA expects all material aspects of the rating system and estimation processes to be monitored• PD and LGD model components should be monitored individually as well as overall model estimates
Model Performance Metrics	<ul style="list-style-type: none">• When assessing the performance of the rating system firms should consider, but not be limited to, analysis on:<ul style="list-style-type: none">i. Model accuracyii. Model discrimination/rank-orderingiii. Ongoing relevance of risk drivers and segmentation approach
Assessment of model deterioration	<ul style="list-style-type: none">• For each performance metric, the PRA expects firms to define triggers outlining model deterioration• In the event of a material model deterioration, the PRA expects firms to take timely mitigating actions• The impact of individual model components in overall model estimates should be clear (e.g. PPGD model with a red status whilst the LGD model is green)
Margin of Conservatism	<ul style="list-style-type: none">• Where margins of conservatism have been added to final model estimates, the PRA expects firms to assess (and revisit) their appropriateness on a regular basis



Model Monitoring

Overview of Expectations specific to PD Models

Area	Expectations
PD Model Scope	<ul style="list-style-type: none"> • The PRA expects management information (MI) to cover material aspects of the PD model, including: <ul style="list-style-type: none"> ○ Application and Behavioural scorecards ○ Rating grades ○ PiT PD estimates ○ LRPD estimates • The analysis produced should be aligned with the structure of the PD model (e.g. segmentation approach) and consider material or strategic risk drivers of the portfolio
PD Model segmentation	<ul style="list-style-type: none"> • The accuracy of model estimates should be assessed on key portfolio segments, even if no bespoke model has been developed. This should include: <ul style="list-style-type: none"> ○ Exposure type: mainstream versus other specialist mortgages, notably Buy-To-Lets ○ Status of exposure: performing versus UTP/ forbearance
PD Model Discrimination	<ul style="list-style-type: none"> • The PRA expects firms assessing model discrimination to do so on the basis of the CRR definition of default • If application or behavioural scorecards have been developed using a 'bad' definition different from the CRR definition of default, the PRA expects the scorecards' discrimination to be assessed using the CRR DoD, in addition to the definitions used for development purposes
PD Model accuracy	<ul style="list-style-type: none"> • The PRA expects firms to compare observed default rates (ODR) with CRR default estimates • For firms using hybrid or through-the-cycle PD models a comparison between observed default rates and Long Run Average PD estimates with no consideration for the economic cycle position is not enough • A statement saying that ODRs are lower than LRPD estimates without any further context is not enough



Model Monitoring

Overview of Expectations specific to LGD Models

Area	Expectations
LGD Model Scope	<ul style="list-style-type: none"> • The PRA expects MI to cover material aspects of the LGD model, including: <ul style="list-style-type: none"> ○ Probability of Possession Given Default (and any scorecards used to estimate possessions, if applicable) ○ Forced Sale Discount ○ 'All-in' collateral haircut ○ 'Time to' parameters • The analysis produced should be aligned with the structure of the LGD model (e.g. segmentation approach) and consider material or strategic risk drivers of the portfolio
LGD Model accuracy	<ul style="list-style-type: none"> • The PRA expects firms to compare realised losses with model estimated losses on a like for like basis. Consideration should be given to the outcome window used to calculate both estimates (e.g. 2-year realised losses being compared with loss estimates calculated over a 5-year outcome window would not meet PRA expectations) • The PRA expects firms to review the assumptions used to determine downturn periods and downturn estimates ensuring their ongoing appropriateness and level of conservatism • A statement saying that observed losses are lower than downturn LGD estimates without any further context is not enough
Incomplete workouts in LGD estimates	<ul style="list-style-type: none"> • The PRA expects firms to monitor the impact of unresolved accounts on all relevant model sub-components like probability of possession given default and 'time to' parameters
Long outcome windows in LGD model estimates	<ul style="list-style-type: none"> • The PRA expects firms to monitor their actual possession rates over an outcome period matching that used in the calculation of their regulatory estimates • However, the PRA also expects that recent emerging possessions, cures and unresolved accounts are monitored prior to the availability of a complete outcome period post default (i.e. vintage analysis). This should mitigate the risk that realised LGDs lag model estimates

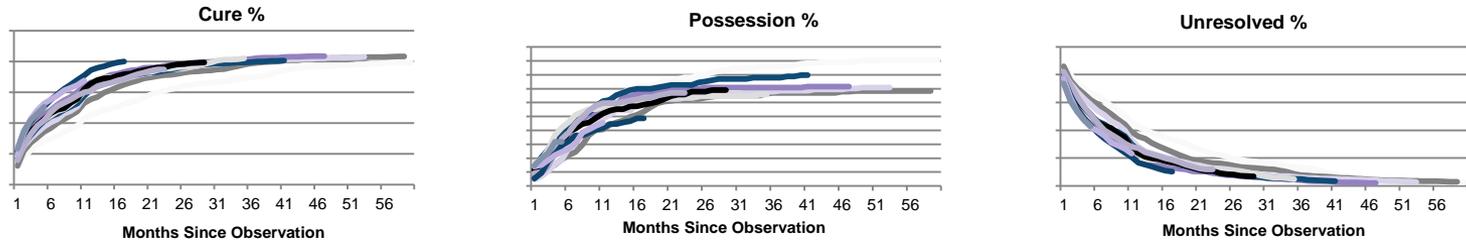


Model Monitoring

Long outcome periods – PPGD model

- ✓ The PRA expect firms to monitor their actual possession rates over an outcome period matching that used in the calculation of their regulatory estimates

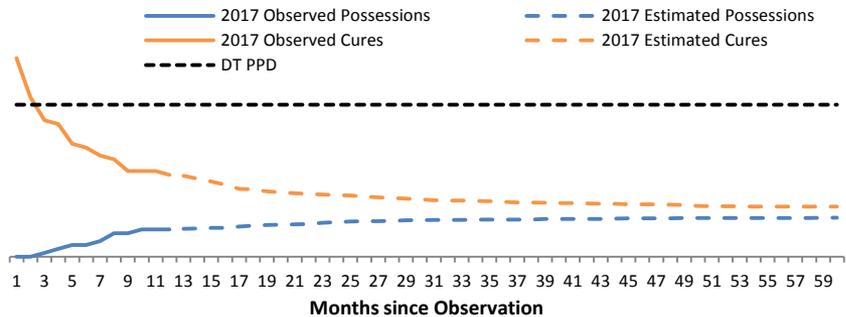
The below charts are an example of how to monitor possession and cure events over long periods:



- ✓ The PRA expects that recent emerging possessions, cures and unresolved accounts are monitored prior to the availability of a complete outcome period post default

Possession rates are estimated over long outcome windows. The assumption is that at the end of the outcome window, defaulted accounts have either cured or been repossessed (i.e. there are no unresolved accounts). The outcome period is used as a ‘proxy’ for a ‘lifetime’ event

How do we ensure that early events are in line with expectations?



- In this example, the most recent 12 month observed possessions and cures (represented by the hard lines) are extrapolated to the end of the outcome window (represented by the dashed lines)
- The lifetime assumption in this example is 60 months

