

EBA/GL/2017/16

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Guidelines on PD estimation, LGD estimation and the treatment of defaulted exposures

1 Compliance and reporting obligations

Status of these guidelines

1. This document contains guidelines issued pursuant to Article 16 of Regulation (EU) No 1093/2010¹. In accordance with Article 16(3) of Regulation (EU) No 1093/2010, competent authorities and financial institutions must make every effort to comply with the guidelines.
2. Guidelines set out the EBA's view of appropriate supervisory practices within the European System of Financial Supervision or of how Union law should be applied in a particular area. Competent authorities as defined in Article 4(2) of Regulation (EU) No 1093/2010 to whom guidelines apply should comply by incorporating them into their practices as appropriate (e.g. by amending their legal framework or their supervisory processes), including where guidelines are directed primarily at institutions.

Reporting requirements

3. In accordance with Article 16(3) of Regulation (EU) No 1093/2010, competent authorities must notify the EBA as to whether they comply or intend to comply with these guidelines, or otherwise give reasons for non-compliance, by ([dd.mm.yyyy]). In the absence of any notification by this deadline, competent authorities will be considered by the EBA to be non-compliant. Notifications should be sent by submitting the form available on the EBA website to compliance@eba.europa.eu with the reference 'EBA/GL/201x/xx'. Notifications should be submitted by persons with appropriate authority to report compliance on behalf of their competent authorities. Any change in the status of compliance must also be reported to the EBA.
4. Notifications will be published on the EBA website, in line with Article 16(3).

¹ Regulation (EU) No 1093/2010 of the European Parliament and of the Council of 24 November 2010 establishing a European Supervisory Authority (European Banking Authority), amending Decision No 716/2009/EC and repealing Commission Decision 2009/78/EC, (OJ L 331, 15.12.2010, p.12).

2 Subject matter, scope and definitions

2.1 Subject matter

5. These guidelines specify the requirements for the estimation of probability of default (PD) and loss given default (LGD), including LGD for defaulted exposures (LGD in-default) and best estimate of expected loss (EL_{BE}) in accordance with Part Three, Title II, Chapter 3, Section 6 of Regulation (EU) No 575/2013, Article 159 of that Regulation and the EBA final draft regulatory technical standards on the IRB assessment methodology EBA/RTS/2016/03 [RTS on IRB assessment methodology] of 21 July 2016².

2.2 Scope of application

6. These guidelines apply in relation to the IRB Approach in accordance with Part Three, Title II, Chapter 3 of Regulation (EU) No 575/2013 for all methods based on own estimates of PD and LGD. Where, for exposures other than retail, an institution has received permission to use the IRB Approach but has not received permission to use own estimates of LGD in accordance with Article 143(2) in conjunction with Article 151(8) to (9) of that Regulation, all parts of these guidelines apply, except Chapters 6 and 7. These guidelines do not apply to the calculation of own funds requirements for dilution risk in accordance with Article 157 of Regulation (EU) No 575/2013.

2.3 Addressees

7. These guidelines are addressed to competent authorities as defined in point (i) of Article 4(2) of Regulation (EU) No 1093/2010 and to financial institutions as defined in Article 4(1) of Regulation (EU) No 1093/2010.

2.4 Definitions

8. Unless otherwise specified, terms used and defined in Regulation (EU) No 575/2013 and Directive 2013/36/EU have the same meaning in these guidelines. In addition, for the purposes of these guidelines, the following definitions apply:

Risk parameters	One or all of the following: PD, LGD, EL_{BE} and LGD in-default
Reference data set (RDS)	All the datasets used for the purpose of estimation of risk parameters, including the datasets relevant for model development as well as the datasets used for calibration of a risk parameter.

² References to Articles of the RTS on IRB assessment methodology will be replaced with references to the Delegated Regulation adopting the EBA final draft RTS on IRB assessment methodology, once that is published in the Official Journal of the EU.

PD model	All data and methods used as part of a rating system within the meaning of Article 142(1) point (1) of Regulation (EU) No 575/2013, which relate to the differentiation and quantification of own estimates of PD and which are used to assess the default risk for each obligor or exposure covered by that model.
Ranking method of a PD model	The method, forming part of a PD model, used to rank the obligors or exposures with respect to the risk of a default.
Scoring method of a PD model	A ranking method of a PD model which assigns ordinal values ('scores') to rank obligors or exposures.
LGD model	All data and methods used as part of a rating system within the meaning of Article 142(1) point (1) of Regulation (EU) No 575/2013, which relate to the differentiation and quantification of own estimates of LGD, LGD in-default and EL_{BE} and which are used to assess the level of loss in the case of default for each facility covered by that model.
EL_{BE}	Expected loss best estimate for defaulted exposures as referred to in Article 181(1)(h) of Regulation (EU) No 575/2013.
LGD in-default	Loss given default for defaulted exposures as referred to in Article 181(1)(h) of Regulation (EU) No 575/2013.
Scope of application of a PD or LGD model	The type of exposures in the meaning of point (2) of Article 142(1) of Regulation (EU) No 575/2013 covered by a PD model or an LGD model.
Estimation of risk parameters	The full modelling process related to the risk parameters including the selection and preparation of data, model development and calibration.
Model development	The part of the process of the estimation of risk parameters that leads to an appropriate risk differentiation by specifying relevant risk drivers, building statistical or mechanical methods to assign exposures to obligor or facility grades or pools, and estimating intermediate parameters of the model, where relevant.
PD calibration sample	The data set on which the ranking or pooling method is applied in order to perform the calibration.
Calibration segment	A uniquely identified subset of the scope of application of the PD or LGD model which is jointly calibrated.



PD calibration	The part of the process of the estimation of risk parameters which leads to appropriate risk quantification by ensuring that when the PD ranking or pooling method is applied to a calibration sample, the resulting PD estimates correspond to the long-run average default rate at the level relevant for the applied method.
LGD calibration	The part of the process of the estimation of risk parameters which leads to appropriate risk quantification by ensuring that the LGD estimates correspond to the long-run average LGD, or to the downturn LGD estimate where this is more conservative, at the level relevant for the applied method.
Application of risk parameters	The assignment of risk parameters estimated in accordance with the PD or LGD model to the current exposures, performed either automatically with the use of a relevant IT system or manually by qualified personnel of an institution.
Application portfolio	The actual portfolio of exposures within the scope of application of the PD or LGD model at the time of the estimation of a risk parameter.

3 Implementation

3.1 Date of application

9. These guidelines apply from 1 January 2021. Institutions should incorporate the requirements of these guidelines in their rating systems by that time, but competent authorities may accelerate the timeline of this transition at their discretion.

3.2 First application of the Guidelines

10. The internal validation function should verify the changes which are applied to the rating systems as a result of the application of these guidelines and the regulatory technical standards to be developed in accordance with Article 144(2) of Regulation (EU) No 575/2013, and the classification of the changes in accordance with Commission Delegated Regulation (EU) No 529/2014³.
11. Institutions that need to obtain prior permission from competent authorities in accordance with Article 143(3) of Regulation (EU) No 575/2013 and Regulation (EU) No 529/2014 for the changes in the rating systems required to incorporate these guidelines for the first time by the deadline referred to in paragraph 9 should agree with their competent authorities the final deadline for submitting the application for such prior permission.

³ OJ L 148, 20.5.2014, p. 36.

4 General estimation requirements

4.1 Principles for specifying the range of application of the rating systems

12. A rating system in the sense of point (1) of Article 142(1) of Regulation (EU) No 575/2013 should cover all those exposures where the obligors or facilities show common drivers of risk and credit-worthiness and fundamentally comparable availability of credit-related information. The PD and LGD model within a rating system may comprise various calibration segments. Where all obligors or exposures within the range of application of the PD or LGD model are jointly calibrated the whole scope of application of the model is considered one calibration segment.
13. Exposures covered by the same rating system should be treated similarly by the institution in terms of risk management, decision making and credit approval process and should be assigned to a common obligor rating scale for the purposes of Article 170(1)(b) of Regulation (EU) No 575/2013 and a common facility rating scale for the purposes of Article 170(1)(e) of that Regulation.
14. For the purpose of quantification of various risk parameters within a rating system, institutions should apply the same definition of default for the same historical observations used in different models. Institutions should also apply the same treatment of multiple defaults of the same obligor or exposure across internal, external and pooled data sources.

4.2 Data requirements

4.2.1 Quality of data

15. In order to comply with the requirement of Article 76 of the RTS on IRB assessment methodology that institutions should have sound policies, processes and methods for assessing and improving the quality of data used for the purpose of credit risk measurement and management processes, institutions should ensure that those policies apply to all data used in model development and calibration, as well as to the data used in the application of the risk parameters.
16. In order for the data used in the model development and in the application of risk parameters as inputs into the model to meet the requirements of accuracy, completeness and appropriateness specified in Article 174(b) of Regulation (EU) No 575/2013, it should be sufficiently precise to avoid material distortions of the outcome of the assignment of exposures to obligors or facility grades or pools, and it should not contain any biases which make the data unfit for purpose.

4.2.2 Governance for data representativeness

17. In order to comply with the requirement of the representativeness of data used in the PD and LGD models specified in Articles 174(c), 179(1)(d) and 179(2)(b) of Regulation (EU) No 575/2013 as well as in Articles 40 and 45 of the RTS on IRB assessment methodology, institutions should have sound policies, processes and methods for assessing the representativeness of data used for the purpose of estimation of risk parameters. Institutions should specify in their internal policies the statistical tests and metrics to be used for the purpose of assessing the representativeness of data used for risk differentiation and, separately, for data underlying the risk quantification. Institutions should also specify methods for qualitative assessment of data for the cases, defined in their policies, where the application of statistical tests is not possible.
18. Institutions should use the same standards and methods for the assessment of representativeness of data stemming from different sources, including internal, external and pooled data or a combination of these, unless different methods are justified by the specificity of the data source or availability of information.
19. Where external or pooled data are used institutions should obtain sufficient information from the data providers to assess the representativeness of such external or pooled data to the institutions' own portfolios and processes.

4.2.3 Representativeness of data for model development

20. Institutions should analyse the representativeness of data in the case of statistical models and other mechanical methods used to assign exposures to grades or pools, as well as in the case of statistical default prediction models generating default probability estimates for individual obligors or facilities. Institutions should select an appropriate dataset for the purpose of model development to ensure that the performance of the model on the application portfolio, in particular its discriminatory power, is not significantly hindered by insufficient representativeness of data.
21. For the purposes of ensuring that the data used in developing the model for assigning obligors or exposures to grades or pools is representative of the application portfolio covered by the relevant model, as required in Article 174(c) of Regulation (EU) No 575/2013 and Article 40(2) of the RTS on IRB assessment methodology institutions should analyse the representativeness of the data at the stage of model development in terms of all of the following:
 - (a) the scope of application;
 - (b) the definition of default;
 - (c) the distribution of the relevant risk characteristics;
 - (d) lending standards and recovery policies.
22. For the purpose of paragraph 21(a) institutions should analyse the segmentation of exposures and consider whether there were any changes to the scope of application of the considered model over the period covered by the data used in developing the model for assigning obligors or exposures to grades or pools. Where such changes were observed institutions should analyse

the risk drivers relevant for the change of the scope of application of the model by comparing their distribution in the RDS before and after the change as well as with the distribution of those risk drivers in the application portfolio. For this purpose institutions should apply statistical methodologies such as cluster analysis or similar techniques to demonstrate representativeness. In the case of pooled models the analysis should be performed with regard to the part of the scope of the model that is used by an institution.

23. For the purpose of paragraph 21(b) institutions should ensure that the definition of default underlying the data used for model development is consistent over time and, in particular, that it is consistent with all of the following:
 - (a) that adjustments have been made to achieve consistency with the current default definition where the default definition has been changed during the observation period;
 - (b) that adequate measures have been adopted by the institution, where the model covers exposures in several jurisdictions having or having had different default definitions;
 - (c) that the definition of default in each data source has been analysed separately;
 - (d) that the definition of default used for the purposes of model development does not have a negative impact on the structure and performance of the rating model, in terms of risk differentiation and predictive power, where this definition is different from the definition of default used by the institution in accordance with Article 178 of Regulation (EU) No 575/2013.
24. For the purpose of paragraph 21(c) institutions should analyse the distribution and range of values of key risk characteristics of the data used in developing the model for risk differentiation in comparison with the application portfolio. With regard to LGD models, institutions should perform such analysis separately for non-defaulted and defaulted exposures.
25. Institutions should analyse the representativeness of the data in terms of the structure of the portfolio by relevant risk characteristics based on statistical tests specified in their policies to ensure that the range of values observed on these risk characteristics in the application portfolio is adequately reflected in the development sample. Where the application of statistical tests is not possible, institutions should carry out at least a qualitative analysis on the basis of the descriptive statistics of the structure of the portfolio, taking into account the possible seasoning effects referred to in Article 180(2)(f) of Regulation (EU) No 575/2013. When considering the results of this analysis, institutions should take into account the sensitivity of the risk characteristics to economic conditions. Material differences in the key risk characteristics between the data sample and the application portfolio should be addressed, for example by using another data sample or a subset of observations or by adequately reflecting these risk characteristics as risk drivers in the model.
26. For the purpose of paragraph 21(d) institutions should analyse whether, over the relevant historical observation period, there were significant changes in their lending standards or recovery policies or in the relevant legal environment, including changes in insolvency law, legal

foreclosure procedures and any legal regulations related to realisation of collaterals, which may influence the level of risk or the distribution or ranges of the risk characteristics in the portfolio covered by the considered model. Where institutions observe such changes they should compare the data included in the RDS before and after the change of the policy. Institutions should ensure comparability of the current underwriting or recovery standards with those applied to the observations included in the RDS and used for model development.

27. Within the PD model the representativeness of data used in developing the model for risk differentiation does not require that the proportion of defaulted and non-defaulted exposures in this dataset be equal to the proportion of defaulted and non-defaulted exposures in the institution's application portfolio. However, institutions should have a sufficient number of defaulted and non-defaulted observations in the development dataset and they should document the difference.

4.2.4 Representativeness of data for calibration of risk parameters

28. In order for institutions to ensure that the data used in risk quantification is representative of the application portfolio covered by the relevant model in accordance with Sub-section 2 of Section 6 of Chapter 3 in Part Three of Regulation (EU) No 575/2013 and Article 45(2) of the RTS on IRB assessment methodology, institutions should analyse the comparability of the data used for the purpose of calculating long-run average default rates or long-run average LGDs as referred to in Article 179(1)(d) of Regulation (EU) No 575/2013 and, where relevant, the representativeness of the pool in accordance with Article 179(2)(b) of that Regulation, in terms of all of the following:
 - (a) the scope of application;
 - (b) the definition of default;
 - (c) the distribution of the relevant risk characteristics;
 - (d) the current and foreseeable economic or market conditions;
 - (e) lending standards and recovery policies.
29. For the purpose of paragraph 28(a) institutions should perform an analysis as specified in paragraph 22.
30. For the purpose of paragraph 28(b) and in order to ensure that the definition of default underlying the data used for risk quantification from each data source is consistent with the requirements of Article 178 of Regulation (EU) No 575/2013, institutions should compare the definition of default applied by the institution currently with the definitions used for the observations included in the dataset used for risk quantification. Where the definition of default has changed during the historical observation period institutions should assess the representativeness of historical data included in the RDS and used for risk quantification in the same way as specified for external data in Chapter 6 of the EBA Guidelines on the application of the definition of default under Article 178 of Regulation (EU) No 575/2013. Where the

definition of default has changed during the historical observation period more than once, institutions should perform the analysis of each of the past definitions of default separately.

31. For the purpose of paragraph 28(c) institutions should perform an appropriate analysis to ensure that at the level of the calibration segment the ranges of values of the key risk characteristics in the application portfolio are comparable to those in the portfolio constituting the reference data set for risk quantification to the degree required to ensure that the risk quantification is not biased.
32. For the purpose of paragraph 28(d) institutions should perform the analysis of the market and economic conditions underlying the data in the following manner:
 - (a) with regard to the PD estimation, in accordance with section 5.3.4;
 - (b) with regard to the LGD estimation, in accordance with section 6.3.2 and taking into account the consideration of economic downturn as required by Article 181(1)(b) of Regulation (EU) No 575/2013.
33. For the purpose of paragraph 28(e) institutions should analyse whether there were significant changes in the lending standards or recovery policies over the relevant historical observation period that may influence the level of risk or the distribution or ranges of the characteristics of relevant risk drivers in the portfolio covered by the considered model. Where institutions observe such changes they should analyse the potential bias in the estimates of risk parameters resulting from these changes in the following manner:
 - (c) with regard to the PD estimation, in terms of the level of default rates and the likely range of variability of default rates;
 - (d) with regard to the LGD estimation, in terms of loss rates, average duration of the recovery processes, frequencies of use of certain recovery scenarios and the loss severity distributions.
34. Where the representativeness of data assessed in accordance with paragraphs 28 to 33 is insufficient and leads to a bias or increased uncertainty of risk quantification, institutions should introduce an appropriate adjustment to correct the bias and they should apply a margin of conservatism in accordance with section 4.4.

4.3 Human judgement in estimation of risk parameters

35. In order for institutions to complement their statistical models with human judgement, as referred to in Articles 174(b), 174(e), 175(4), 179(1)(a) and 180(1)(d) of Regulation (EU) No 575/2013, they should do all of the following:

- (a) assess the modelling assumptions and whether the selected risk drivers contribute to the risk assessment in line with their economic meaning;
- (b) analyse the impact of the human judgement on the performance of the model and ensure that any form of human judgement is properly justified;
- (c) document the application of human judgement in the model, including at least the criteria for the assessment, rationale, assumptions, experts involved and description of the process.

4.4 Treatment of deficiencies and margin of conservatism

4.4.1 Identification of deficiencies

36. Institutions should identify all deficiencies related to the estimation of risk parameters that lead to a bias in the quantification of those parameters or to an increased uncertainty that is not fully captured by the general estimation error, and classify each deficiency into one of the following categories:

- (a) Category A: Identified data and methodological deficiencies;
- (b) Category B: Relevant changes to underwriting standards, risk appetite, collection and recovery policies and any other source of additional uncertainty.

37. For the purposes of identifying and classifying all deficiencies referred to in paragraph 36 institutions should take into account all relevant deficiencies in methods, processes, controls, data or IT systems that have been identified by the credit risk control unit, validation function, internal audit function or any other internal or external review and should analyse at least all of the following potential sources of additional uncertainty in risk quantification:

- (a) under category A:
 - (i) missing or materially changed default triggers in historical observations, including changed criteria for recognition of materially past due credit obligations;
 - (ii) missing or inaccurate date of default;
 - (iii) missing, inaccurate or outdated rating assignment used for assessing historical grades or pools for the purpose of calculation of default rates or average realised LGDs per grade or pool;
 - (iv) missing or inaccurate information on the source of cash flows;
 - (v) missing, inaccurate or outdated data on risk drivers and rating criteria;

- (vi) missing or inaccurate information used for the estimation of future recoveries as referred to in paragraph 159;
 - (vii) missing or inaccurate data for the calculation of economic loss;
 - (viii) limited representativeness of the historical observations due to the use of external data;
 - (ix) potential bias stemming from the choice of the approach to calculating the average of observed one year default rates in accordance with paragraph 80;
 - (x) necessity of adjusting the average of observed one-year default rates in accordance with paragraph 86;
 - (xi) missing information for the purpose of estimating loss rates or for the purpose of reflecting economic downturn in LGD estimates;
- (b) under category B:
- (i) changes to underwriting standards, collection or recovery policies, risk appetite or other relevant internal processes;
 - (ii) unjustified deviations in the ranges of values of the key risk characteristics of the application portfolio compared with those of the dataset used for risk quantification;
 - (iii) changes to market or legal environment;
 - (iv) forward-looking expectations regarding potential changes in the structure of the portfolio or the level of risk, especially based on actions or decisions that have already been taken but which are not reflected in the observed data.

4.4.2 Appropriate adjustment

38. In order to overcome biases in risk parameter estimates stemming from the identified deficiencies referred to in paragraphs 36 and 37, institutions should apply adequate methodologies to correct the identified deficiencies to the extent possible. The impact of these methodologies on the risk parameter ('appropriate adjustment'), which should result in a more accurate estimate of the risk parameter ('best estimate'), represents either an increase or a decrease in the value of the risk parameter. Institutions should ensure and provide evidence that the application of an appropriate adjustment results in a best estimate.
39. Institutions should document the methods used to apply appropriate adjustments to rectify the identified deficiencies, where relevant, as well as their justification.

40. Institutions should regularly monitor the adequacy of appropriate adjustments. The adoption of an appropriate adjustment by institutions should not replace the need to address the identified deficiencies.

4.4.3 Margin of conservatism

41. In relation to the requirement that institutions should add a margin of conservatism ('MoC') that is related to the expected range of estimation errors as required by Articles 179(1)(f) and 180(1)(e) of Regulation (EU) No 575/2013, institutions should implement a framework for quantification, documentation and monitoring of estimation errors.

42. The final MoC on a risk parameter estimate should reflect the uncertainty of the estimation in all of the following categories:

Category A: MoC related to data and methodological deficiencies identified under category A as referred to in paragraph 36(a);

Category B: MoC related to relevant changes to underwriting standards, risk appetite, collection and recovery policies and any other source of additional uncertainty identified under category B as referred to in paragraph 36(b);

Category C: the general estimation error.

43. In order to quantify MoC institutions should do all of the following:

- (a) quantify MoC for the identified deficiencies referred to in paragraphs 36 and 37, to the extent not covered by the general estimation error, at least for each of the categories A and B at the level of the calibration segment ensuring that:
 - (i) where appropriate adjustments in the sense of paragraph 38 are used, the MoC accounts for any increase in the uncertainty or additional estimation error associated with these adjustments;
 - (ii) the MoC at category level related to the appropriate adjustments is proportionate to the uncertainty around these adjustments;
 - (iii) the MoC is applied to address the uncertainty of the risk parameter estimate stemming from any deficiencies among those referred to in paragraphs 36 and 37 that have not been corrected via appropriate adjustments as referred to in point (i);
- (b) quantify the general estimation error of category C referred to in paragraph 42 associated with the underlying estimation method at least for every calibration segment; the MoC for the general estimation error should reflect the dispersion of the distribution of the statistical estimator.

44. For the purpose of paragraph 43(a) and for each of the categories A and B, institutions may group all or selected deficiencies, where justified, for the purpose of quantifying MoC.
45. Institutions should quantify the final MoC as the sum of:
 - (a) the MoC under category A as referred to in paragraph 43(a);
 - (b) the MoC under category B as referred to in paragraph 43(a);
 - (c) the MoC for the general estimation error (category C) as referred to in paragraph 43(b).
46. Institutions should add the final MoC to the best estimate of the risk parameter.
47. Institutions should ensure that the impact of the final MoC does not result in lowering the risk parameter estimates and in particular that:
 - (a) the MoC stemming from the general estimation error is greater than zero;
 - (b) the MoC stemming from each of the categories A and B is proportionate to the increased uncertainty in the best estimate of risk parameters caused by the identified deficiencies listed in each category. In any case, the MoC under each of the categories A and B should be greater than or equal to zero.
48. Institutions should consider the overall impact of the identified deficiencies and the resulting final MoC on the soundness of the model and ensure that the estimates of the risk parameters and the resulting own funds requirements are not distorted by the necessity for excessive adjustments.
49. For each rating system, the MoC applied should be documented in the relevant model documentation and methodology manuals. The documentation should contain at least the following:
 - (a) a complete list of all identified deficiencies, including errors and uncertainties, and the potentially affected model components or risk parameters;
 - (b) the category under which these deficiencies are classified, as referred to in paragraph 42;
 - (c) a description of the methods for quantification of the MoC related to identified deficiencies as referred to in paragraph 43(a) and in particular the methodologies used to quantify the MoC per category.
50. Institutions should regularly monitor the levels of the MoC. The adoption of a MoC by institutions should not replace the need to address the causes of errors or uncertainties, or to correct the models to ensure their full compliance with the requirements of Regulation (EU) No 575/2013. Following an assessment of the deficiencies or the sources of uncertainty, institutions should develop a plan to rectify the data and methodological deficiencies as well as



any other potential source of additional uncertainty and reduce the estimation errors within a reasonable timeframe, taking into consideration the materiality of the estimation error and the materiality of the rating system.

51. When reviewing the levels of the MoC institutions should ensure all of the following:
- (a) that the MoC stemming from categories A and B referred to in paragraphs 36 and 37 is included in internal reporting separately for each category and may be reduced over time and eventually eliminated once the deficiencies are rectified in all parts of the rating system that were affected;
 - (b) that the MoC stemming from the general estimation error referred to in paragraph 43(b) is included in internal reporting in a separate category ('C');
 - (c) that the level of the MoC is assessed as part of the regular reviews referred to in Chapter 9 and in particular that the level of MoC related to the general estimation error remains appropriate after the inclusion of the most recent data relevant for the risk parameter estimation.
52. Institutions should ensure that necessary changes in the MoC are implemented in a timely manner.

5 PD estimation

5.1 General requirements specific to PD estimation

53. For the purpose of assigning obligors to an obligor grade as part of the credit approval process in accordance with Article 172(1)(a) of Regulation (EU) No 575/2013 as well as for the purpose of the review of those assignments, in accordance with Article 173(1)(b) of that Regulation, institutions should ensure that each and every natural or legal person towards whom an IRB exposure exists is rated by the institution with the model approved to be used on a given type of exposures. This model should fit the single original obligor within the applicable rating system, including exposures secured by unfunded credit protection as referred to in Article 161(3) of that Regulation.
54. For the purpose of assigning retail exposures to a grade or pool as part of the credit approval process in accordance with Article 172(2) of Regulation (EU) No 575/2013 as well as for the purpose of the review of those assignments in accordance with Article 173(2) of that Regulation, institutions should ensure that each and every IRB exposure is rated by the institution with the model approved to be used on a given type of exposures. This model should fit the single original obligor or exposure within the applicable rating system, including exposures secured by unfunded credit protection as referred to in Article 164(2) of that Regulation.
55. A PD model can contain several different methods for ranking the obligors or exposures as well as various calibration segments.

5.2 Model development in PD estimation

5.2.1 Data requirements specific for model development

56. For the purpose of model development, institutions should ensure that the RDS contains the values of the risk drivers for appropriate points in time. These points in time may vary between different risk drivers. In the selection of appropriate points in time institutions should take into account the dynamics as well as the update frequency of the risk drivers throughout the whole period in which an obligor was in the portfolio and, in the case of a default, throughout the year prior to default.

5.2.2 Risk drivers and rating criteria

57. In the process of selecting risk drivers and rating criteria, institutions should consider a broad set of information relevant to the type of exposures covered by the rating system. Potential risk drivers analysed by institutions should include in particular the following:

- (a) obligor characteristics, including sector and geographic location for corporates;

- (b) financial information, including financial statements or income statements;
 - (c) trend information, including growing or shrinking sales or profit margin;
 - (d) behavioural information, including delinquency and the use of credit facilities.
58. Institutions should ensure that for the purpose of selecting risk drivers and rating criteria the relevant experts from business areas of the institution are consulted with respect to the business rationale and risk contribution of the considered risk drivers and rating criteria.
59. Institutions should ensure that the decrease of reliability of information over time, for instance of information on obligor characteristics obtained at the time of the loan origination, is appropriately reflected in the PD estimation. Institutions should also ensure that the model estimates the proper level of risk with respect to all relevant, currently available and most up-to-date information and that an adequate MoC is applied where a higher degree of uncertainty exists due to the lack of up-to-date information. In particular the model or the assignment process should provide for an adequate and conservative adjustment in both of the following situations:
- (a) in accordance with Article 24(1)(g) of the RTS on IRB assessment methodology, in case of financial statements older than 24 months where information stemming from these financial statements is a relevant risk driver;
 - (b) in the case of credit bureau information that is older than 24 months, if still relevant at that point in time, where credit bureau information is a relevant risk driver.
60. Institutions should use the risk drivers and rating criteria consistently, in particular with respect to the considered time horizon, in model development, model calibration and model application.
61. Where there is a significant proportion of customers using multiple facilities of the same type within a considered retail rating system institutions should analyse the level of risk of such customers compared with customers carrying only one facility of the relevant type and, where necessary, reflect the difference in the level of risk in the model through appropriate risk drivers.

5.2.3 Treatment of ratings of third parties

62. Institutions should have clear policies specifying the conditions under which the rating of a third party who has a contractual or organisational relation with an obligor of the institution may be taken into account in the assessment of risk of the considered obligor. Such policies should take into account the following possible manners in which the rating of such a third party may be taken into account in the assessment of risk of the considered obligor:
- (a) the rating of such third party being transferred to a relevant obligor ('rating transfer'), where there is no difference in risk between the obligor and the related party because of

- the existence of an appropriate guarantee and the rating of a third party is assigned internally in accordance with the rating system for which the institution has received permission in accordance with Article 143(2) of Regulation (EU) No 575/2013;
- (b) the rating of a such third party being taken into account as an indication for an override of the assignment of the relevant obligor to a grade or pool;
 - (c) the rating of such a third party serving as an input to the PD model, reflecting contractual support of the related party for the obligor.
63. In order for an internal or external ratings of a third party to be incorporated into a PD model, institutions should ensure all of the following:
- (a) that the rating of a third party fulfils all the requirements for relevant risk drivers set out in section 5.2.2;
 - (b) that other relevant obligor and transaction risk characteristics are properly reflected in the model in accordance with Articles 170(1)(a) and 170(3)(a) of Regulation (EU) No 575/2013, and that no material biases are introduced by a high weighting of the internal or external rating information;
 - (c) that there is no double counting of effects of any relations to third parties.
64. A rating transfer should not change the assignment of exposures to exposure classes, rating systems or models, but should only affect the assignment to grades or pools. Rating transfers should be set up in such a way that any changes to a rating of a third party which is material information on the obligor or exposure with regard to Article 173(1)(b) of Regulation (EU) No 575/2013 is reflected in all influenced ratings in a timely manner.
65. The material contractual support granted by an obligor to a third party should be seen as diminishing the free financial strength of the supporting obligor, including the strength to repay all obligations to the institution in full. This should be reflected in the rating of the supporting obligor.

5.2.4 Rating philosophy

66. Institutions should choose an appropriate philosophy underlying the assignment of obligors or exposures to grades or pools ('rating philosophy') taking into account all of the following principles:
- (a) Institutions should assess whether the method used to quantify the risk parameter is adequate for the rating philosophy and understand the characteristics and dynamics of the assignment of obligors or exposures to grades or pools ('rating assignment') and of the risk parameter estimates that result from the method used.

- (b) Institutions should assess the adequacy of the resulting characteristics and dynamics of the rating assignment and risk parameter estimates that result from the method used, with regard to their various uses and should understand their impact on the dynamics and volatility of own funds requirements.
 - (c) The rating philosophy should also be taken into account for back testing purposes. Philosophies sensitive to economic conditions tend to estimate PDs that are better predictors of each year's default rates. On the other hand, philosophies less sensitive to economic conditions tend to estimate PDs that are closer to the average PD across the various states of the economy, but that differ from observed default rates in years where the state of the economy is above or below its average. Deviations between observed default rates and the long-run average default rate of the relevant grade will hence be more likely in rating systems less sensitive to economic conditions. In contrast, migrations among grades will be more likely in rating systems which are more sensitive to economic conditions. These patterns should be taken into account when assessing the results of back-testing and, where relevant, benchmarking analysis.
67. Institutions should apply the chosen rating philosophy consistently over time. Institutions should analyse the appropriateness of the philosophy underlying the assignment of obligors or exposures to grades or pools ('rating philosophy'), taking into account all of the following:
- (a) design of risk drivers;
 - (b) migration across grades or pools;
 - (c) changes in the yearly default rates of each grade or pool.
68. Where institutions use different rating systems characterised by different rating philosophies, they should use the information on the rating assignments or risk parameters estimates with caution, especially when making use of rating information or default experience obtained from external rating agencies. Where institutions use different rating systems with different characteristics, such as different philosophies or different levels of objectivity, accuracy, stability, or conservatism, they should ensure that the rating systems have an appropriate level of consistency and that any differences between them are well understood. Such understanding should at least enable the institution to define an appropriate way to combine or aggregate the information produced by the various rating systems when this is necessary according to the institution's policies. Institutions should have full understanding of the assumptions and potential inaccuracies arising from such a combination or aggregation.

5.2.5 Homogeneity of obligor grades or pools

69. In order to comply with the requirements of Article 170(1) and 170(3)(c) of Regulation (EU) No 575/2013 and of Article 38 of the RTS on IRB assessment methodology, institutions should check the homogeneity of obligors or exposures assigned to the same grades or pools. In particular, grades should be defined in such a manner that each obligor within each grade or

pool has a reasonably similar risk of default and that significant overlaps of the distributions of the default risk between grades or pools are avoided.

5.3 PD calibration

5.3.1 Data requirements for the calculation of observed default rates

70. For the purpose of calculating the one-year default rate defined in point (78) of Article 4(1) of Regulation (EU) No 575/2013, institutions should ensure the completeness of the quantitative and qualitative data and other information in relation to the denominator and numerator as outlined in paragraphs 73 and 74 and used for the calculation of the observed average default rate. In particular, institutions should ensure that at least the following data for the relevant observation period referred to in paragraphs 82 to 83 is properly stored and available:

- (a) the criteria for identifying the relevant type of exposures covered by the PD model under consideration;
- (b) the criteria for identifying the calibration segments;
- (c) the risk drivers used for risk differentiation; where a newly relevant risk driver has been included in the model for which no historical data is available institutions should, make efforts to minimise missing data on risk drivers over time as outlined in paragraph 51(a), and apply an appropriate adjustment and a MoC in accordance with section 4.4;
- (d) all identification numbers of obligors and exposures relevant for default rate calculation, taking into account situations where the identification number has changed over time, including changes due to restructuring of exposures.

71. Exclusion of observations from the one-year default rate calculation should be undertaken only in the following two situations:

- (a) obligors wrongly included in the data set of defaults, as they did not default in the meaning of the definition of default pursuant to Article 178 of Regulation (EU) No 575/2013 as further specified in the Guidelines on the application of the definition of default of an obligor under that Article should not be included in the numerator of the one-year default rate;
- (b) obligors wrongly assigned to the considered rating model, despite not falling in the range of application of that rating model, should be excluded from both the numerator and the denominator of the one-year default rate.

72. Institutions should document all data cleansing in accordance with Article 32(3)(b) of the RTS on IRB assessment methodology, with respect to the one-year default rate calculation and in particular:

- (a) for non-retail PD models, a list of all observations within the dataset that were excluded according to paragraph 71, with a case-by-case justification;
- (b) for retail PD models, information on the reasons and quantity of exclusions of observations made in accordance with paragraph 71.

5.3.2 Calculation of one-year default rates

73. For the purpose of calculating the one-year default rate referred to in point (78) of Article 4(1) of Regulation (EU) No 575/2013, institutions should ensure both of the following:
- (a) that the denominator consists of the number of non-defaulted obligors with any credit obligation observed at the beginning of the one-year observation period; in this context a credit obligation refers to both of the following:
 - (i) any on balance sheet item, including any amount of principal, interest and fees;
 - (ii) any off-balance sheet items, including guarantees issued by the institution as a guarantor.
 - (b) that the numerator includes all those obligors considered in the denominator that had at least one default event during the one-year observation period.
74. When assigning the obligors or exposures to grades or pools for the purpose of the one-year default rate calculation, institutions should take overrides into account, but they should not reflect in this assignment any substitution effects due to credit risk mitigation, nor any ex post conservative adjustments introduced in accordance with section 8.1. Where the one-year default rate is calculated by rating grade or pool, the denominator should refer to all obligors assigned to a rating grade or pool at the beginning of the observation period. Where the one-year default rate is calculated at the portfolio level, the denominator should refer to all obligors assigned to the relevant calibration segment at the beginning of the observation period.
75. Institutions should calculate the one-year default rate also for the subset of obligors with any credit obligation that did not have a rating at the start of the relevant observation period, but which were within the range of application of the model under consideration ('missing ratings'), even if these obligors were assigned to a rating grade or pool in a conservative manner for the purpose of calculation of own funds requirements. Obligor whose ratings are based on missing or partly missing information or where the rating is outdated but still deemed valid by the institution should not be considered as missing ratings.
76. For the purposes of paragraphs 73 to 75 an obligor has to be included in the denominator and, where relevant, numerator, also in the case of a migration to a different rating grade, pool or rating model, rating system or approach to calculation of capital requirements within the observation period or where the corresponding credit obligations were sold, written off, repaid or otherwise closed during the observation period. Institutions should analyse whether such

migrations or sales of credit obligations bias the default rate and, if so, they should reflect this in an appropriate adjustment and consider an adequate MoC.

77. In any case institutions should ensure that each defaulted obligor is counted only once in the numerator and denominator of the one-year default rate calculation, even where the obligor defaulted more than once during the relevant one-year period.
78. In order to choose an appropriate calculation approach as required by paragraph 80, institutions should evaluate the observed one year default rates within the historical observation period at least quarterly.

5.3.3 Calculation of the observed average default rate

79. The observed average of one-year default rates ('observed average default rate') should be calculated for each rating grade or pool and additionally for the type of exposures covered by the relevant PD model as well as for any relevant calibration segment.
80. Institutions should choose an appropriate approach between an approach based on overlapping and an approach based on non-overlapping one-year time windows, to calculate the observed average default rate based on a documented analysis. This analysis should include at least the following:
 - (a) an analysis of possible bias due to the proportion of short-term and terminated contracts that cannot be observed during the relevant one-year periods;
 - (b) an analysis of possible bias due to the specific calculation dates chosen;
 - (c) for institutions using overlapping one-year time windows, an analysis of potentially significant bias due to implicit over-weighting of the overlapping time period;
 - (d) an analysis of potentially significant bias due to seasonal effect related to the chosen calculation dates.
81. For the purposes of paragraphs 79 and 80 institutions should calculate the observed average default rates as the arithmetic average of all one year default rates calculated in accordance with paragraphs 73 to 76. In the case of PD models for retail exposure class institutions may calculate the observed average default rate as a weighted average of one-year default rates where an institution does not give equal importance to historic data because more recent data is a better predictor of losses in accordance with Article 180(2)(e) of Regulation (EU) No 575/2013.

5.3.4 Long-run average default rate

82. For the purpose of determining the historical observation period referred to in Articles 180(1)(h) and 180(2)(e) of Regulation (EU) No 575/2013, additional observations to the most recent 5 years, at the time of model calibration, should be considered relevant when these observations are required in order for the historical observation period to reflect the likely

range of variability of default rates of that type of exposures as referred to in Article 49(3) of the RTS on IRB assessment methodology.

83. For the purpose of assessing the representativeness of the historical observation period referred to in paragraph 82 for the likely range of variability of one-year-default rates, institutions should assess whether the historical observation period contains a representative mix of good and bad years, and they should take into account all of the following:

- (a) the variability of all observed one-year-default rates;
- (b) the existence, lack or prevalence of one-year default rates relating to bad years as reflected by economic indicators that are relevant for the considered type of exposures within the historical observation period;
- (c) significant changes in the economic, legal or business environment within the historical observation period.

84. Where the historical observation period referred to in paragraph 82 is representative of the likely range of variability of the default rates, the long-run average default rate should be computed as the observed average of the one-year default rates in that period.

85. Where the historical observation period referred to in paragraph 82 is not representative of the likely range of variability of default rates as referred to in Article 49(4) of the RTS on IRB assessment methodology, institutions should apply the following:

- (a) where no or insufficient bad years are included in the historical observation period the average of observed one year default rates should be adjusted in order to estimate a long-run average default rate;
- (b) where bad years are over-represented in the historical observation period, the average of observed one-year default rates may be adjusted to estimate a long-run average default rate where there is a significant correlation between economic indicators referred to in paragraph 83(b) and the available one-year default rates.

Institutions should ensure that, as a result of the adjustments referred to in points (a) and (b), the adjusted long-run average default rate reflects the likely range of variability of default rates.

86. In the exceptional case where the long-run average default rate is below the average of all observed one-year default rates due to any adjustment made in accordance with paragraph 85, institutions should compare their adjusted long-run average default rates with the higher of the following:

- (a) the observed average of the one-year default rates of the most recent 5 years;
- (b) the observed average of all available one-year default rates.

Institutions should justify the direction and magnitude of the adjustment, including the adequacy of the considered MoC, in line with the requirement in Article 49(4)(b) of the RTS on IRB assessment methodology and section 4.4. In addition, where the adjusted long-run average default rate is lower than the higher of the two values referred to in points (a) and (b), they should specifically justify why these two values are not appropriate.

5.3.5 Calibration to the long-run average default rate

87. Institutions should have sound and well-defined processes in place which ensure sound calibration by including all of the following in their calibration process:
- (a) quantitative calibration tests by rating grade or pool;
 - (b) quantitative calibration tests on calibration segment level;
 - (c) supplementary qualitative analyses such as expert judgements on the shape of the resulting obligor distribution, minimum obligor numbers per grade and avoidance of undue concentration in certain grades or pools.
88. Institutions should store and describe in the documentation of the PD model the calibration sample associated with each calibration segment. In order to ensure compliance with Article 180(1)(a) or 180(2)(a) of Regulation (EU) No 575/2013, institutions should find an appropriate balance between the comparability of the calibration sample with the application portfolio in terms of obligor and transaction characteristics and its representativeness of the likely range of variability of default rates as referred to in section 5.3.4.
89. Institutions should conduct the calibration after taking into account any overrides applied in the assignment of obligors to grades or pools, and before the application of MoC or floors to PD estimates as referred to in Articles 160(1) and 163(1) of Regulation (EU) No 575/2013. Where a ranking method or overrides policy has changed over time, institutions should analyse the effects of these changes on the frequency and scope of overrides and take them into account appropriately.
90. The process of grouping ranked obligors or exposures to grades or pools, in particular where institutions conduct this grouping by identification of intervals of score values reflecting a predefined PD level assigned to a grade of a master scale, may be performed during the calibration.
91. Taking into account the availability of data, the structure of the model and portfolio as well as the business requirements, institutions should choose an appropriate method to perform the calibration in accordance with the following principles:
- (a) institutions may choose one of the following types of calibration:
 - (i) a calibration in accordance with Article 180(1)(a) or 180(2)(a) of Regulation (EU) No 575/2013;

- (ii) a calibration in accordance with Article 169(3) of Regulation (EU) No 575/2013 in combination with Article 180(1)(a) or 180(2)(a) of that Regulation if a continuous rating scale is used;
 - (b) for exposures to corporates, institutions, central governments and central banks and for equity exposures where an institution uses the PD/LGD approach set out in Article 155(3) of Regulation (EU) No 575/2013, institutions may choose one of the following types of calibration:
 - (i) a calibration based on a mapping to the rating scale used by an external credit assessment institution (ECAI) or similar organisation in accordance with Article 180(1)(f) of Regulation (EU) No 575/2013;
 - (ii) for a statistical default prediction model, in accordance with Section 4 of the RTS on IRB assessment methodology, where the PDs are estimated as simple averages of default probability estimates for individual obligors in a given grade or pool in accordance with Article 180(1)(g) of Regulation (EU) No 575/2013, a calibration at the level of appropriate calibration segments of the relevant default probability estimates;
 - (c) for retail exposures institutions may choose a calibration based on total losses and LGDs in accordance with Articles 180(2)(b) and 180(2)(d) of Regulation (EU) No 575/2013;
 - (d) for corporate purchased receivables institutions may choose a calibration based on expected losses and LGDs in accordance with Articles 180(1)(b) and 180(1)(c) of Regulation (EU) No 575/2013.
92. For the purpose of determining the PD estimates referred to in paragraph 91, the calibration should consider either:
- (a) the long-run average default rate at the level of grade or pool, in which case institutions should provide additional calibration tests at the level of the relevant calibration segment;
or
 - (b) the long-run average default rate at the level of the calibration segment, in which case institutions should provide additional calibration tests at the level of the relevant grades or pools or, where they use direct PD estimates in accordance with Article 169(3) of Regulation (EU) No 575/2013, at a level that is appropriate for the application of the probability model.
93. Irrespective of which of the approaches mentioned in paragraph 92 institutions choose, they should assess the potential effect of the chosen calibration method on the behaviour of PD estimates over time.
94. For the purpose of determining PD estimates based on a mapping to an external rating scale as referred to in paragraph 91(b)(i), institutions should base the default rates observed for the

external organisation's grades on a time series representative of the likely range of variability of default rates for the grades and pools of the given portfolio.

95. Where institutions derive PD estimates from the estimates of losses and LGDs in accordance with Articles 161(2) and 180(2)(b) of Regulation (EU) No 575/2013 they should use a RDS that includes realised losses on all defaults identified during the historical observation period specified in accordance with section 6.3.2.1 and relevant drivers of loss.
96. In order to use direct PD estimates for the calculation of own funds requirements in accordance with Article 169(3) of Regulation (EU) No 575/2013, institutions should demonstrate that the theoretical assumptions of the probability model underlying the estimation methodology are met to a sufficient extent in practice and that the long-run average default rate is retained. In particular, all data and representativeness requirements should be met, including those in Article 174(c) of Regulation (EU) No 575/2013, and the definition of default should be applied in accordance with Article 178 of Regulation (EU) No 575/2013. Under no circumstances should the use of continuous PDs or any smoothing of default rates be adopted in order to overcome the lack of data, low discriminatory capacity or any other deficiencies in the rating assignment or PD estimation process, or to reduce the own funds requirements.
97. Institutions may split exposures covered by the same PD model into as many different calibration segments as needed where one or more subsets of these exposures carry a significantly different level of risk. For this purpose institutions should use relevant segmentation drivers and they should justify and document the use and scope of the calibration segments.
98. Where scoring methods are used, institutions should ensure that:
 - (a) where there is a change in the scoring method used, the institutions consider whether it is necessary to recalculate scores of obligors or exposures based on the original dataset instead of using scores that were calculated based on previous versions of the scoring method, and, where such recalculation is not possible, that institutions assess potential effects and take those effects into account via an appropriate increase of the MoC to their PD estimates;
 - (b) where Article 180(1)(g) of Regulation (EU) No 575/2013 applies, the PD estimates which were derived as a simple average of individual PD estimates are adequate for relevant grades, by applying calibration tests to these estimates at a grade level, on the basis of one-year default rates representative of the likely range of variability of default rates.
99. The calibration should not influence the rank ordering of obligors or exposures within a calibration segment other than within each grade or pool.

6 LGD estimation

6.1 General requirements specific to LGD estimation

6.1.1 LGD estimation methodologies

100. Institutions that have obtained permission to use own estimates of LGD in accordance with Article 143(2) of Regulation (EU) No 575/2013 should assign an LGD estimate to each non-defaulted exposure and an estimate of LGD in-default and EL_{BE} to each defaulted exposure within the range of application of the rating system subject to such permission in accordance with Articles 172 and 173 of Regulation (EU) No 575/2013. Institutions should estimate LGDs for all facility grades of the distinct facility rating scale or for all pools that are incorporated in the rating system. For the purpose of LGD estimation institutions should treat each defaulted facility as a distinct default observation, unless more than one independent defaults were recognised on a single facility which do not meet the conditions of paragraph 101.
101. For the purpose of LGD estimation, with regard to defaults recognised on a single facility, where the time between the moment of the return of the exposure to non-defaulted status and the subsequent classification as default is shorter than nine months, institutions should treat such exposure as having been constantly defaulted from the first moment when the default occurred. Institutions may specify a period longer than nine months for the purpose of considering two subsequent defaults as a single default in the LGD estimation, if this is adequate to the specific type of exposures and reflects the economic meaning of the default experience.
102. Institutions should estimate their own LGDs based on their own loss and recovery experience, as it is reflected in historical data on defaulted exposures. Institutions may supplement their own historical data on defaulted exposures with external data. In particular, institutions should not derive their LGD estimates only from the market prices of financial instruments, including, but not limited to, marketable loans, bonds or credit default instruments, but they may use this information to supplement their own historical data.
103. Where in the case of retail exposures and purchased corporate receivables institutions derive LGD estimates from realised losses and appropriate estimates of PDs in accordance with Articles 161(2) and 181(2)(a) of Regulation (EU) No 575/2013 they should ensure that:
- (a) the process for estimating total losses meets the requirements of Article 179 of Regulation (EU) No 575/2013 and the outcome is consistent with the concept of LGD as set out in Article 181(1)(a) of this Regulation, as well as with the requirements specified in Chapter 6, in particular with the concept of economic loss as specified in section 6.3.1;
 - (b) the process for estimating PD meets the requirements of Articles 179 and 180 of Regulation (EU) No 575/2013 as well as the requirements specified in Chapter 5.

104. An LGD model can contain several different methods, especially with respect to different types of collateral, which are combined to arrive at an LGD for a given facility.
105. Institutions should be able to demonstrate that the methods that they choose for the purpose of LGD estimation are appropriate to their activities and the type of exposures to which the estimates apply and they should be able to justify the theoretical assumptions underlying those methods. The methods used in the LGD estimation should in particular be consistent with the collection and recovery policies adopted by the institution and should take into account possible recovery scenarios as well as potential differences in the legal environment in relevant jurisdictions.
106. The methods used by the institution in the LGD estimation, the assumptions underlying these methods, the institution's consideration of any downturn effect, the length of data series used, the MoC, the human judgement and, where applicable, the choice of risk drivers, should be adequate to the type of exposures to which they are applied.

6.1.2 Data requirements for LGD estimation

107. For the purpose of LGD estimation institutions should use an RDS covering all of the following items:
 - (a) all defaults identified during the historical observation period specified in accordance with section 6.3.2.1;
 - (b) all data necessary for calculating realised LGDs in accordance with section 6.3.1;
 - (c) relevant factors that can be used to group the defaulted exposures in meaningful ways and relevant drivers of loss, including their values at the moment of default and at least within the year before default when available.
 108. Institutions should include in the RDS information on the results of the recovery processes, including recoveries and costs, related to each individual defaulted exposure. To this end institutions should include:
 - (a) information on the results of incomplete recovery processes until the reference date for the LGD estimation;
 - (b) information on the results of recovery processes at portfolio level, where such aggregation of the information is justified, and in particular in the case of indirect costs and sale of a portfolio of credit obligations.
 - (c) information on external or pooled data used in the estimation of LGDs.
 109. The RDS should contain at least the following information:
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- (a) obligor-related, transaction-related and institution-related risk characteristics as well as external factors as referred to in paragraph 121 that are potential risk drivers at the relevant reference dates as specified in paragraph 122;
 - (b) moment (date) of default;
 - (c) all default triggers that have occurred, including both past due events and unlikelihood to pay events, even after the identification of default; in the case of exposures subject to distressed restructuring the amount by which the financial obligation has diminished calculated in accordance with the EBA Guidelines on the definition of default;
 - (d) the outstanding amount of the exposure at the moment of default including principal, interest and fees;
 - (e) the amounts and timing of the additional drawings after default;
 - (f) the amounts and timing of write-offs;
 - (g) the values of collaterals associated with the exposure and, where applicable, the type of valuation (such as market value or mortgage lending value as defined in points (74) and (76) of Article 4(1) of Regulation (EU) No 575/2013), date of valuation, a flag of whether the collateral has been sold and the sale price;
 - (h) information on any dependence between the risk of the obligor and the risk of the collateral or collateral provider;
 - (i) the types, amounts and maturities of unfunded credit protection including the specification and credit quality of the protection provider;
 - (j) the amounts, timing and sources of recoveries;
 - (k) the amounts, timing and sources of direct costs associated with recovery processes;
 - (l) a clear identification of the type of termination of the recovery process;
 - (m) where applicable, currency mismatches between two or more of the following elements: the currency unit used by the institution for financial statements, the underlying obligation, any funded or unfunded credit protection and any cash flows from the liquidation of the obligor's assets;
 - (n) amount of realised loss.
110. In accordance with Article 229(1) of Regulation (EU) No 575/2013 institutions may use various methods for the valuation of the collateral in the form of immovable property including in particular market value or mortgage lending value as defined in points (74) and (76) of Article 4(1) of that Regulation. Where institutions use various valuation approaches with regard to

immovable properties that secure exposures included in the range of application of a certain rating system, they should collect and store in the RDS the information on the type of valuation and they should use this information consistently in the LGD estimation and in the application of LGD estimates.

111. Where institutions derive LGD estimates from realised losses and appropriate estimates of PDs in accordance with Articles 161(2) and 181(2)(a) of Regulation (EU) 575/2013 they should use a RDS that includes realised losses on all defaults identified during the historical observation period specified in accordance with section 6.3.2.1 and relevant drivers of loss.
112. Where aggregated information is collected and stored, institutions should develop an appropriate methodology for the allocation of recoveries and costs to individual defaulted exposures and should apply this methodology consistently across exposures and over time. In any case institutions should demonstrate that the process of allocation of recoveries and costs is effective and that it does not lead to biased LGD estimates.
113. Institutions should demonstrate that they collect and store in their databases all information required to calculate direct and indirect costs. All material indirect costs should be allocated to the corresponding exposures. This cost allocation process should be based on the same principles and techniques that institutions use in their own cost accounting systems. For the purpose of indirect cost allocation institutions may use methods based on exposure weighted averages, or statistical methods based on a representative sample within the population of defaulted obligors or facilities.
114. Institutions should take reasonable steps to recognise the sources of the cash flows and allocate them adequately to the specific collateral or unfunded credit protection that has been realised. Where the source of the cash flows cannot be identified, institutions should specify clear policies for the treatment and allocation of such recovery cash flows, which should not lead to a bias in LGD estimation.

6.1.3 Recoveries from collaterals

115. Institutions should recognise the recoveries as stemming from collaterals in all of the following situations:
 - (a) the collateral is sold by the obligor and the obtained price has been used to cover parts or all of the outstanding amount of the defaulted credit obligation;
 - (b) the collateral is repossessed or sold by the institution, the parent undertaking or any of its subsidiaries on behalf of the institution;
 - (c) the collateral is sold in a public auction of the property by court order or in a similar procedure in accordance with the applicable legal framework;

- (d) the credit obligation is sold together with the collateral and the sale price for the credit obligation included the existing collateral;
 - (e) in the case of leasing, the leasing object is sold by the institution;
 - (f) the collateral is realised by any other method that is eligible under the legal framework of the relevant jurisdiction.
116. For the purpose of point (b) of paragraph 115 institutions should determine the value of repossession as the value by which the credit obligation of the obligor has been diminished as a result of the repossession of the collateral, and with which the repossessed collateral was recorded as an asset on the balance sheet of the institution. Where these values are different institutions should consider the lower of the two the value of repossession. The value of repossession should be considered a value of recovery at the date of repossession and should be included in the calculation of the economic loss and realised LGD in accordance with section 6.3.1.
117. Institutions should consider whether the value of repossession adequately reflects the value of the repossessed collateral, consistently with any established internal requirements for collateral management, legal certainty and risk management. Where the collateral repossessed meets the criteria for high quality liquid assets at Level 1, as defined in Article 10 of Commission Delegated Regulation (EU) 2015/61, institutions may take into account directly as a realised recovery the market value of the collateral at the time of the repossession. In all other cases institutions should apply an appropriate haircut to the value of repossession and include in the calculation of economic loss a recovery in the amount of the value of repossession after applying the appropriate haircut. Institutions should estimate this haircut taking into account all of the following conditions:
- (a) the haircut should reflect possible errors in the valuation of the collateral at the moment of repossession taking into account the type of the valuation available at the moment of repossession, the date it was performed and the liquidity of the market for this type of asset;
 - (b) the haircut should be estimated with the assumption that the institution intends to sell the repossessed collateral to an independent third party and should reflect the potential price that could be achieved from such sale, the costs of the sale and the discounting effect for the period from the sale to the moment of repossession taking into account the liquidity of the market for this type of assets;
 - (c) where there are observations available regarding the repossessions and subsequent sales of similar types of collaterals the estimation of the haircut should be based on these observations and should be regularly backtested; for this purpose institutions should take into account all of the following:

- (i) the difference between the value of repossession and the sale price, especially where there were no significant changes in market and economic conditions between the moment of the repossession and the moment of the sale;
 - (ii) any income and costs related to this asset that were observed between the date of repossession and the moment of the sale;
 - (iii) discounting effects;
 - (iv) whether the institution reposessed the collateral with the intention of immediate sale or whether another strategy was adopted.
- (d) where historical observations regarding the repossessions and subsequent sales of similar types of collaterals are not available the estimation of the haircut should be based on a case-by-case assessment, including the analysis of the current market and economic conditions;
- (e) the fewer data an institution has on previous repossessions and the less liquid the market for the given type of assets is, the more uncertainty is attached to the resulting estimates, which should be adequately reflected in the MoC in accordance with section 4.4.3.
118. In any case the repossession of collateral should be recognised at the moment of repossession and should not prevent the institution from closing the recovery process in accordance with paragraph 155.
119. Any sale of credit obligations in accordance with point (d) of paragraph 115 should be included in the LGD estimation in a manner appropriate to the LGD estimation methodology taking into account all of the following conditions:
- (a) where institutions regularly sell credit obligations as part of their recovery processes, they should appropriately reflect the observations related to credit obligations subject to the sale in the model development process;
 - (b) where institutions do not regularly sell credit obligations as part of their recovery processes and the allocation of the part of the price related to collaterals is too burdensome to make or too unreliable, they may decide not to take these observations into account in the process of model development;
 - (c) institutions should not treat recoveries from the sales of the secured credit obligations as recoveries realised without the use of collaterals unless they can demonstrate that the recoveries related to these collaterals are immaterial;
 - (d) in any case institutions should include all observations, including the sales of credit obligations, in the calculation of long-run average LGD.

120. In accordance with point (f) of paragraph 115 institutions may specify and recognise any other forms of realising collaterals adequate to the types of collaterals used by the institution that are eligible under the applicable legal framework. When recognising such other forms of realising collateral, institutions should take into account the fact that the collateral may take various forms and that various forms of collaterals may be related to the same asset. Where different forms of collateral refer to the same asset but the realisation of one of the collaterals does not decrease the value of the other, institutions should consider them separate collaterals in the process of LGD estimation. In particular, institutions should recognise separately the form of collateral which gives a right to repossess or sell the asset (such as a mortgage) and the form of collateral which gives a right to collect cash flows generated by the asset (such as a cession of rent or fees).

6.2 Model development in LGD estimation

6.2.1 Risk drivers

121. Institutions should identify and analyse potential risk drivers that are relevant to their specific circumstances and to the specific characteristics of the type of exposures covered by the rating system. Potential risk drivers analysed by institutions should include in particular the following:

- (a) transaction-related risk characteristics, including type of product, type of collateral, geographical location of the collateral, unfunded credit protection, seniority, Loan-to-Value ratio (LTV), exposure size, seasoning, and recovery procedures;
- (b) obligor-related risk characteristics, including, where applicable, size, capital structure, geographical region, industrial sector, and line of business;
- (c) institution-related factors, including internal organisation and internal governance, relevant events such as mergers, and existence of specific entities within the group dedicated to recoveries;
- (d) external factors, including interest rates, legal framework and other factors influencing the expected length of the recovery process.

122. Institutions should analyse the risk drivers not only at the moment of default but also at least within a year before default. Institutions should use a reference date for a risk driver that is representative of the realisations of the risk driver within a year before default. When choosing the appropriate reference date for a risk driver institutions should take into account its volatility over time. Institutions should apply these practices also with regard to the reference date of the valuation of collateral; the value of the collateral at the reference date should not reflect the impact of the decrease in credit quality of the exposure shortly before default.

123. Institutions should specify or calculate the risk drivers in the application of LGD estimates in the same way as they are specified or calculated in the estimation of LGD.

6.2.2 Eligibility of collaterals

124. In accordance with Articles 170 and 181(1)(f) of Regulation (EU) No 575/2013 institutions may take into account in their LGD estimations the existence of any types of collaterals for which they have established internal requirements in terms of collateral management, legal certainty and risk management that are generally consistent with those set out in Section 3 of Chapter 4 of Title II in Part Three of that Regulation. In the case of the types of collateral that are not specified in Chapter 4 of Title II in Part Three of that Regulation institutions may use those types of collaterals in their LGD estimations where their policies and procedures relating to internal requirements for valuation and legal certainty of these collaterals are appropriate to the respective type of collateral.
125. To the extent that LGD estimates take into account the existence of unfunded credit protection institutions should specify the criteria and methodology for recognising and including in their LGD estimates the protection in the form of guarantees and credit derivatives that meet the criteria specified in Article 60 of the RTS on IRB assessment methodology.
126. Institutions should take into account as a risk driver or segmentation criterion information on all main types of collaterals that are used within the scope of application of the LGD model. Institutions should clearly define in their internal policies the main and other types of collaterals used for the type of exposures covered by the rating system and should ensure that, to the extent that LGD estimates take into account the existence of collateral, the policies regarding the management of these types of collateral comply with the requirement of Article 181(1)(f) of Regulation (EU) No 575/2013. Institutions should specify the main types of collaterals in such a way that the cash flows from the remaining types of collaterals will not significantly bias the estimation of recoveries that are realised without the use of collaterals.
127. Collaterals which do not meet the requirement of Article 181(1)(f) of Regulation (EU) No 575/2013 cannot be included as a risk driver in the LGD estimation and the cash flows received from those collaterals should be treated as if they had been received without the use of collaterals. Regardless of this treatment in the LGD estimation, institutions should collect the information about the source of the cash flows related to those collaterals and allocate them as related to those collaterals. Institutions should regularly monitor the levels of such cash flows as well as the extent to which the relevant types of collaterals are used. Where necessary, institutions should perform appropriate adjustments in order to avoid any bias in the LGD estimates.

6.2.3 Inclusion of collaterals in the LGD estimation

128. For the purpose of LGD estimation institutions may group the types of collaterals that are homogeneous in terms of recovery patterns taking into account both the average time of collection process and the recovery rates on these types of collaterals.
129. The approach developed by institutions to include the effect of collaterals in the LGD estimation should meet all of the following conditions:
- (a) institutions should avoid the bias that may stem from including the cash flows related to realisation of collateral in the estimation of recoveries that are realised without the use of collaterals and vice versa;
 - (b) where institutions estimate separate recovery rates for specific types of collaterals, they should avoid a bias that may stem from including in the estimation sample the observations where the exposure was secured by only a part of the value of the collateral. For this purpose institutions should take reasonable steps to obtain the data on the total value of the collateral and total sale price of the collateral and include this information in the estimation where it is available;
 - (c) where institutions estimate separate recovery rates for specific types of collaterals they should recognise and include in this estimation direct costs related to the collection on each of these specific types of collaterals separately as well;
 - (d) where institutions estimate separate recovery rates for specific types of collaterals they should include in this estimation all recoveries realised from a specific type of collateral including those realised on exposures where the realisation of the collateral has been completed but the overall recovery process has not yet been closed;
 - (e) where the same collateral covers several exposures, institutions should specify an adequate allocation methodology in order to avoid double counting of collaterals; the allocation methodology should be consistent between the LGD estimation and the application of LGD estimates and with the methodology used for accounting purposes;
 - (f) the estimates should not be based solely on the estimated market value of the collateral but they should also take into account the realised recoveries from past liquidations and the potential inability of an institution to gain control and liquidate the collateral. For this purpose, institutions should take into account in the estimation those historical observations where the collateral could not be realised or where the recovery process was longer than expected, due to inability or difficulty to gain control or liquidate the collateral. Where institutions estimate the recovery rates related to specific types of collaterals, they should take into account the time between the moment of default and the time when the cash flows related to the collection on these types of collaterals have been received and should include in the estimation those observations where the collateral has not been realised as a result of inability to gain control;

- (g) the estimates should take into account the potential decreases in collateral value from the point of LGD estimation to the eventual recovery, in particular those resulting from changes in the market conditions, the state and age of the collateral and, where relevant, currency fluctuations. Where institutions have experienced decreases in values of collaterals and these are already reflected in observed recoveries, no further adjustments to the LGD estimates based on these observations should be made. Where potential decreases in values of collaterals are not reflected in historical observations or where institutions predict further, potentially more severe decreases in the future, they should be included in the quantification of LGD estimates by means of an appropriate adjustment based on forward-looking expectations. However, the LGD estimates should not be adjusted to take into account any potential increases in collateral value;
- (h) the estimates should take into account in a conservative manner the degree of dependence between the risk of the obligor and the risk of the diminishing value of the collateral as well as the cost of liquidating the collateral.

6.2.4 Homogeneity of facility grades or pools

130. In order to fulfil the requirement of Article 38 of the RTS on IRB assessment methodology, institutions should assess the homogeneity of exposures assigned to the same grades or pools based on the data in the RDS and they should ensure, in particular, that grades are defined in such a manner that individual grades are sufficiently homogeneous with respect to loss characteristics.

6.3 LGD calibration

6.3.1 Calculation of economic loss and realised LGD

6.3.1.1 Definition of economic loss and realised LGD

131. For the purpose of LGD estimation as referred to in Article 181(1)(a) of Regulation (EU) No 575/2013, institutions should calculate realised LGDs for each exposure, as referred to in point (55) of Article 4(1) of that Regulation, as a ratio of the economic loss to the outstanding amount of the credit obligation at the moment of default, including any amount of principal, interest or fee.
132. For the purpose of paragraph 131, institutions should calculate the economic loss realised on an instrument (i.e. defaulted facility), as referred to in point (2) of Article 5 of Regulation (EU) No 575/2013 as a difference between:
- (a) the outstanding amount of the credit obligation at the moment of default, without prejudice to paragraph 140, including any amount of principal, interest or fee, increased by material direct and indirect costs associated with collecting on that instrument discounted to the moment of default; and

- (b) any recoveries realised after the moment of default discounted to the moment of default.
133. For the purpose of calculation of the economic loss realised on an exposure in accordance with paragraph 132 institutions should take into account all realised recoveries including the recoveries from unknown sources and recoveries related to collaterals that do not meet the requirement of Article 181(1)(f) of Regulation (EU) No 575/2013.
134. Where, relating to a default event, any part of exposure has been forgiven or written off before or at the date of default and the amount forgiven or written off is not included in the outstanding amount of the credit obligation at the moment of default the amount of the exposure that was forgiven or written off should be added to the outstanding amount of the credit obligation at the moment of default for both the calculation of economic loss as specified in paragraph 132 in the numerator, and the calculation of the outstanding amount of credit obligation in the denominator of the realised LGD.
135. In the case of exposures that return to non-defaulted status, institutions should calculate economic loss as for all other defaulted exposures with the only difference that an additional recovery cash flow should be added to the calculation as if a payment had been made by the obligor in the amount that was outstanding at the date of the return to non-defaulted status, including any principal, interests and fees ('artificial cash flow'). This artificial cash flow should be discounted to the moment of default in the same manner as all observed cash flows. Where the exposures meet the criteria of paragraph 101, the realised LGD should be calculated with the reference to the date of the first default event taking into account all cash flows observed from the date of the first default event, including those observed during the period between the first and the second defaulted status, without adding any artificial cash flows.
136. Where institutions open new facilities to replace previously defaulted facilities as part of restructuring or for technical reasons, they should calculate the realised LGDs based on the originally defaulted facilities. For this purpose, institutions should have a sound mechanism to allocate observed costs, recoveries and any additional drawings to original facilities.

6.3.1.2 Treatment of fees, interest and additional drawings after default

137. For the purpose of Article 181(1)(i) of Regulation (EU) No 575/2013, institutions should take into account in the calculation of realised LGD any fees for delays in payments that have been capitalised in the institution's income statement before the moment of default by including them in the outstanding amount of the credit obligation at the moment of default in the numerator and denominator of the realised LGD. Where the fees were extended to the obligor in order to recover direct costs already incurred by the institution and these costs are already included in the calculation of the economic loss, institutions should not add these amounts to the economic loss or outstanding amount again. Any fees capitalised after the moment of default should not increase the amount of economic loss or amount outstanding at the moment of default. However, all recoveries, including those related to fees capitalised after default, should be included in the calculation of economic loss.

138. Institutions should apply the treatment specified in paragraph 137 to any interest capitalised in the institution's income statement before and after the moment of default.
139. In accordance with Article 182(1)(c) of Regulation (EU) No 575/2013 institutions that obtained permission to use own estimates of LGD and conversion are required to reflect the possibility of additional drawings by the obligor up to and after the time of default in their estimates of conversion factors. In the case of retail exposures, in accordance with Articles 181(2)(b) and 182(3) of this Regulation institutions may reflect future drawings either in their conversion factors or in their LGD estimates. These future drawings should be understood as additional drawings by the obligor after the moment of default.
140. Where institutions include additional drawings by the obligor after the moment of default in their conversion factors they should calculate realised LGD as a ratio of the economic loss to the outstanding amount of the credit obligation at the moment of default increased by the amount of additional drawings by the obligor after the moment of default discounted to the moment of default.
141. For retail exposures, where institutions do not include additional drawings by the obligor after the moment of default in their conversion factors they should calculate realised LGD as a ratio of the economic loss to the outstanding amount of the credit obligation at the moment of default and they should not increase the denominator of the ratio by the value of additional drawings by the obligor after the moment of default.
142. Irrespective of whether institutions reflect future drawings in their conversion factors or in their LGD estimates they should calculate the economic loss used in the numerator of the realised LGD including the additional drawings after the moment of default and all realised recoveries discounted to the moment of default.

6.3.1.3 Discounting rate

143. For the purpose of the calculation of economic loss, in accordance with point (2) of Article 5 of Regulation (EU) No 575/2013, institutions should discount all recoveries, costs and additional drawings after the moment of default using an annual discounting rate composed of a primary interbank offered rate applicable at the moment of default increased by an add-on of 5%-points. For this purpose the primary interbank offered rate should be considered the 3-month EURIBOR or a comparable liquid interest rate in the currency of the exposure.

6.3.1.4 Direct and indirect costs

144. For the purpose of the calculation of the realised LGDs, institutions should take into account all material direct and indirect cost related to the recovery process. Where any material direct or indirect costs relating to the collection on exposures and the default of the respective counterparty have been incurred before the moment of default institutions should include these costs in the LGD estimation unless at least one of the following conditions is met:

- (a) these costs are clearly included in the outstanding amount of the credit obligation at the moment of default;
 - (b) these costs are associated with the previous default of the same obligor, which is not considered a multiple default in accordance with paragraph 101.
145. Direct costs should include the costs of outsourced collection services, legal costs, the cost of hedges and insurances and all other costs directly attributable to the collection on a specific exposure. Institutions should consider all direct costs as material.
146. Indirect costs should include all costs stemming from the running of the institution's recovery processes, overall costs of outsourced collection services not included as direct costs, and all other costs related to the collection on defaulted exposures that cannot be directly attributed to collection on a specific exposure. Institutions should include in their estimation of indirect costs an appropriate percentage of other ongoing costs, such as institutions' overheads related to the recovery processes, unless they can demonstrate that these costs are immaterial.

6.3.2 Long-run average LGD

6.3.2.1 Historical observation period

147. The historical observation period should be as broad as possible and should contain data from various periods with differing economic circumstances. For this purpose institutions should at a minimum select a historical observation period in such a way that:
- (a) the length of the historical observation period, i.e. the timespan between the oldest default considered in the RDS and the moment of the LGD estimation, covers at least the minimum length specified in Article 181(1)(j) of Regulation (EU) No 575/2013 for exposures to corporates, institutions, central governments and central banks and, for retail exposures, the period specified in Article 181(2) subparagraph 2 of that Regulation and, where applicable, Commission Delegated Regulation adopting technical standards laid down in Article 181(3)(b) of that Regulation;
 - (b) it ensures that the RDS includes a sufficient number of closed recovery processes in order to provide robust LGD estimates;
 - (c) it is composed of consecutive periods and includes the most recent periods before the moment of LGD estimation;
 - (d) it includes the full period for which the institution is reasonably able to replicate the currently applicable definition of default;
 - (e) all available internal data is considered 'relevant', as referred to in Articles 181(1)(j) and 181(2) subparagraph 2 of Regulation (EU) No 575/2013 and is included in the historical observation period.

148. In assessing whether the RDS includes a sufficient number of closed recovery processes in accordance with paragraph 147(b), institutions should take into account the number of closed recovery processes in the total number of observations.

6.3.2.2 Calculation of long-run average LGD

149. In accordance with letter (a) of Article 181(1) of Regulation (EU) No 575/2013 institutions are required to calculate the long-run average LGD separately for each facility grade or pool. In this context institutions should calculate the long-run average LGD also at the level of the portfolio covered by the LGD model. In the calculation of long-run average LGD institutions should use all defaults observed in the historical observation period that fall within the scope of the LGD model.
150. Without prejudice to Article 181(2) of Regulation (EU) No 575/2013 institutions should calculate the long-run average LGD as an arithmetic average of realised LGDs over a historical observation period weighted by a number of defaults. Institutions should not use for that purpose any averages of LGDs calculated on a subset of observations, in particular any yearly average LGDs, unless they use this method to reflect higher weights of more recent data on retail exposures in accordance with Article 181(2) of Regulation (EU) No 575/2013.
151. Where institutions do not give equal importance to all historical data for retail exposures in accordance with Article 181(2) of Regulation (EU) No 575/2013 they should be able to demonstrate in a documented manner that the use of higher weights for more recent data is justified by better prediction of loss rates. In particular where zero or very small weights are applied to specific periods this should be duly justified or lead to more conservative estimates.
152. In specifying the weights in accordance with paragraph 151 institutions should take into account the representativeness of data assessed in accordance with section 4.2.4 as well as the economic and market conditions that are represented by the data.

6.3.2.3 Treatment of incomplete recovery processes

153. For the purposes of letter (a) of Article 181(1) of Regulation (EU) No 575/2013, in relation to the use of all defaults observed during the historical observation period within the data sources for LGD estimation, institutions should ensure that the relevant information from incomplete recovery processes is taken into account in a conservative manner. The LGD estimation should be based on the long-run average LGD.
154. Institutions should calculate the observed average LGD for each facility grade or pool and at the level of the portfolio covered by the LGD model taking into account realised LGDs on all defaults observed in the historical observation period related to closed recovery processes in accordance with paragraphs 155 to 157 without including any expected future recoveries. The observed average LGD should be weighted by the number of defaults included in the calculation.

155. Institutions should clearly specify in their internal policies the moment of closing the recovery processes. All recovery processes that have been closed should be treated as such for the purpose of the calculation of the observed average LGD.
156. Institutions should define the maximum period of the recovery process for a given type of exposures from the moment of default that reflects the expected period of time observed on the closed recovery processes during which the institution realises the vast majority of the recoveries, without taking into account the outlier observations with significantly longer recovery processes. The maximum period of the recovery processes should be specified in a way that ensures sufficient data for the estimation of the recoveries within this period for the incomplete recovery processes. The length of the maximum period of the recovery processes may be different for different types of exposures. The specification of the maximum period of the recovery process should be clearly documented and supported by evidence of the observed recovery patterns, and should be coherent with the nature of the transactions and the type of exposures. Specification of the maximum period of the recovery process for the purpose of the long-run average LGD should not prevent institutions from taking recovery actions where necessary, even with regard to exposures which remain in default for a period of time longer than the maximum period of the recovery process specified for this type of exposures.
157. For the purpose of the calculation of the observed average LGD, institutions should recognise without undue delay as closed recovery processes all exposures in default which fall into at least one of the following categories:
- (a) exposures for which the institution does not expect to take any further recovery actions;
 - (b) exposures that remain in defaulted status for a period of time longer than the maximum period of the recovery process specified for this type of exposures;
 - (c) exposures fully repaid or written-off;
 - (d) exposures that have been reclassified to non-defaulted status.

With regard to the defaulted exposures falling under the categories in points (a) and (b), all recoveries and costs realised before or at the time of estimation should be considered for the purpose of the calculation of the observed average LGD, including any recoveries realised after the maximum period of the recovery processes.

158. Institutions should obtain the long-run average LGD by adjusting the observed average LGD taking into account the information related to processes that were not closed ('incomplete recovery processes') and where the time from the moment of default until the moment of estimation is shorter than the maximum period of the recovery process specified for this type of exposures. For these processes, institutions should comply with both of the following:
- (a) they should take into account all observed costs and recoveries;

- (b) they may estimate future costs and recoveries, both those stemming from the realisation of the existing collaterals and those to be realised without the use of collaterals within the maximum period of the recovery processes.

159. The estimation referred to in paragraph 158(b) should comply with the following principles:

- (a) for the purpose of estimation of the future costs and recoveries institutions should analyse the costs and recoveries realised on these exposures until the moment of estimation, in comparison with the average costs and recoveries realised during a similar period of time on similar exposures; for this purpose institutions should analyse the recovery patterns observed on both closed and incomplete recovery processes, taking into account only costs and recoveries realised up to the moment of estimation;
- (b) the assumptions underlying the expected future costs and recoveries as well as the adjustment to the observed average LGD should be:
 - i. proven accurate through back-testing;
 - ii. based on a reasonable economic rationale;
 - iii. proportionate, taking into consideration that LGD estimates should be based on the long-run average LGD that reflects the average LGDs weighted by the number of defaults using all defaults observed during a historical observation period.
- (c) in estimating the future recoveries institutions should take into account the potential bias stemming from incomplete recovery processes being characterised by longer average recovery processes or lower average recoveries than closed recovery processes;
- (d) in estimating the future recoveries stemming from the realisation of the existing collaterals institutions should take into account the legal certainty of the claims on the collateral and realistic assumptions regarding the possibility of its realisation;
- (e) the adjustment of the observed average LGD may be estimated at the level of individual exposures, at the level of grade or pool or at the level of portfolio covered by the LGD model;
- (f) any uncertainty related to the estimation of the future recoveries on incomplete recovery processes should be reflected in an adequate MoC applied in accordance with section 4.4.

6.3.2.4 Treatment of cases with no loss or positive outcome

160. Where institutions observe that they realised profit on their observations of defaults, the realised LGD on these observations should equal zero for the purpose of calculation of the observed average LGD and the estimation of the long-run average LGD. Institutions may use the information on the realised LGDs before the application of this floor in the process of model development for the purpose of risk differentiation.

6.3.3 Calibration to the long-run average LGD

161. Institutions should calibrate their LGD estimates to the long run average LGD calculated in accordance with section 6.3.2. For this purpose institutions should choose a calibration method that is appropriate for their LGD estimation methodology from the following approaches:
- (a) the calibration of LGD estimates to the long-run average LGD calculated for each grade or pool, in which case they should provide additional calibration tests at the level of the relevant calibration segment;
 - (b) the calibration of LGD estimates to the long-run average LGD calculated at the level of calibration segment, in particular where they use direct LGD estimates in accordance with Article 169(3) of Regulation (EU) No 575/2013, including where they use LGD estimation methodology based on intermediate parameters. In this case institutions should at least compare this long-run average LGD with the average LGD estimate applied to the same set of observations as those used for calculating the long-run average LGD and, where necessary, correct the individual LGD estimates for the application portfolio accordingly, for instance by using a scaling factor. Where realised values are higher than estimated values at the level of calibration segment, institutions should correct the estimates upwards or readjust their estimation in order to reflect their loss experience.
162. Where institutions observe extremely high values of realised LGDs much above 100%, especially for exposures with small outstanding amounts at the moment of default, they should identify relevant risk drivers to differentiate these observations and adequately reflect these specific characteristics in the assignment to grades or pool. Where institutions use a continuous rating scale in the LGD estimation, they may create a separate calibration segment for such exposures.
163. In order to comply with the requirement of Article 181(1)(a) of Regulation (EU) No 575/2013 to use all observed defaults in LGD quantification, institutions should not exclude any defaults observed in the historical observation period that fall within the scope of application of the LGD model.
164. In the analysis of the representativeness of data in accordance with section 4.2.4, institutions should take into account not only the current characteristics of the portfolio but also, where relevant, the changes to the structure of the portfolio that are expected to happen in the foreseeable future due to specific actions or decisions that have already been taken. Adjustments made on the basis of the changes expected in the foreseeable future should not lead to a decrease in the estimates of LGD parameter.

7 Estimation of risk parameters for defaulted exposures

7.1 General requirements specific to EL_{BE} and LGD in-default estimation

7.1.1 Estimation methodologies for EL_{BE} and LGD in-default

165. Institutions that have obtained permission to use own estimates of LGD in accordance with Article 143(2) of Regulation (EU) No 575/2013, should assign an EL_{BE} estimate and an LGD in-default estimate to each defaulted exposure within the range of application of the rating system subject to such permission.
166. Institutions should estimate EL_{BE} and LGD in-default for each of the facility grades of the distinct facility rating scale or for each of the pools that are used within the rating system.
167. For the purposes of EL_{BE} and LGD in-default estimation, and unless otherwise specified in this Chapter, institutions should use the same estimation methods used for estimating LGD on non-defaulted exposures, as set out in Chapter 6.
168. Institutions should take into consideration all relevant post-default information in their EL_{BE} and LGD in-default estimates in a timely manner, in particular where events from the recovery process invalidate the recovery expectations underlying the most recent estimates.
169. Institutions should assess and duly justify situations where the estimates of LGD in-default shortly after the date of default systematically deviate from the LGD estimates immediately before the date of default at the facility grade or pool, where these deviations do not stem from the use of risk drivers that are applicable only from the date of default onwards.
170. Institutions should perform back-testing and benchmarking of their EL_{BE} and LGD in-default estimates in accordance with points (b) and (c) respectively, of Article 185 of Regulation (EU) No 575/2013.

7.1.2 Reference dates

171. For the purposes of EL_{BE} and LGD in-default estimation, institutions should set the reference dates to be used for grouping defaulted exposures in accordance with the recovery patterns observed. These reference dates should be used in the estimation of EL_{BE} and LGD in-default instead of the date of default. For the purposes of setting the reference dates institutions should use information only on closed recovery processes taking into account costs and recoveries only if observed up to the date of estimation.

172. Each of the reference dates referred to in paragraph 171 could be any of the following:
- (a) a specific number of days after the date of default; this option would be appropriate in particular where the estimation refers to a portfolio of exposures showing a stable recovery pattern through time;
 - (b) a relevant date associated with a specific event at which significant breaks in the recovery profile are observed; this option would be appropriate in particular where the estimation refers to a portfolio of exposures that are subject to significant changes of the recovery patterns associated with certain specific events, for instance at the date of realisation of collateral;
 - (c) any combination of the cases referred to in points (a) and (b) that better reflects the recovery patterns; this option would be appropriate in particular where the estimation refers to a portfolio of exposures showing a stable recovery pattern through time but for which breaks in such recovery patterns are observed around certain specific events, for instance at collection, and where the reference dates following those events are defined as a specific number of days after the recovery event, rather than after the date of default;
 - (d) where appropriate, the reference date can have any value between zero and the number of days until the end of the maximum period of the recovery process set by the institution for the type of exposures in question.
173. For the purposes of EL_{BE} and LGD in-default estimation the same defaulted exposures in the RDS should be used at all relevant reference dates considered in the model.
174. Institutions should monitor on a regular basis potential changes in the recovery patterns and in the relevant recovery policies which may affect the estimation of EL_{BE} and LGD in-default at each reference date.

7.1.3 Data requirements for EL_{BE} and LGD in-default estimation

175. For the purposes of EL_{BE} and LGD in-default estimation, institutions should use the same RDS referred to in section 6.1.2, complemented by any relevant information observed during the recovery process and at each reference date, specified in accordance with paragraphs 171 to 174 and, in particular at least the following additional information:
- (a) all relevant factors that can be used to group defaulted exposures, and all relevant drivers of loss, including those that may become relevant after the date of default and at each reference date;
 - (b) the amount outstanding at each reference date;
 - (c) the values of any collateral associated with the defaulted credit obligations and their dates of valuation after the date of default.

7.2 Model development in the estimation of EL_{BE} and LGD in-default

176. For the purposes of taking into account the information on the time in-default and recoveries realised so far, in accordance with Article 54(2)(b) of the RTS on IRB assessment methodology institutions may take into account this information either directly as risk drivers or indirectly, for instance by setting the reference date for estimation, as referred to in paragraphs 171 to 174.
177. For the purpose of EL_{BE} and LGD in-default estimation, institutions should analyse the potential risk drivers referred to in paragraph 121 not only until the moment of default but also after the date of default and until the date of termination of the recovery process. Institutions should analyse also other potential risk drivers that might become relevant after the date of default, including in particular the expected length of the recovery process and the status of the recovery process. Institutions should use the values of risk drivers as well as the values of collateral adequate to the reference dates specified in accordance with paragraphs 171 to 174.

7.3 Calibration of EL_{BE} and LGD in-default

7.3.1 Calculation of realised LGD and long-run average LGD for defaulted exposures

178. For the purposes of EL_{BE} and LGD in-default estimation, institutions should calculate the realised LGDs for defaulted exposures, in accordance with section 6.3.1 with the only difference that this should be done with regard to each of the reference dates specified in accordance with paragraphs 171 to 174, rather than the date of default. In the calculation of the realised LGD at a given reference date institutions should include all fees and interest capitalised before the reference date and they should discount all subsequent cash flows and drawings to the reference date.
179. Where, after the moment of default, institutions write-off part of the exposure the calculation of the economic loss and the realised LGD should be based on the full amount of the outstanding credit obligation, without taking into account the partial write-off. However, where institutions regularly write-off parts of exposures based on a consistent policy in terms of the time and proportion of the write-off, they may include this information in the calibration of final EL_{BE} and LGD in-default. Where institutions perform write-offs in a less regular manner, they may reflect the information about the partial write-off of a specific exposure in the application of these parameters to this exposure by overriding the output of the rating assignment process in accordance with section 8.2 in order to ensure consistency between the LGD estimation and the application of the LGD estimates.
180. For the purposes of EL_{BE} and LGD in-default estimation, institutions should calculate the long run average LGD of the realised LGDs for defaulted exposures, referred to in paragraph 178, following the requirements set out in section 6.3.2 with the only exception that, for each

reference date, incomplete recovery processes should be used only if their relevant reference date for the application of the EL_{BE} and LGD in-default parameters is posterior to the reference date under consideration for the estimation.

181. In accordance with section 6.3.2.3 institutions should not estimate any future recoveries for exposures that remain in defaulted status for a period of time longer than the maximum length of the recovery process as specified by the institution. However, relevant information regarding specific exposures, in particular information about existing collateral, may be reflected in the application of these parameters by overriding the output of the rating assignment process in accordance with section 8.2.

7.3.2 Specific requirements for EL_{BE} estimation

7.3.2.1 Consideration of MoC in EL_{BE} estimation

182. For the purpose of Article 181(1)(h) of Regulation (EU) No 575/2013 the EL_{BE} should not include any MoC in the sense of section 4.4.3.

7.3.2.2 Current economic circumstances

183. For the purposes of considering current economic circumstances in their EL_{BE} estimates, as required by Article 181(1)(h) of Regulation (EU) No 575/2013, institutions should take into account economic factors, including macroeconomic and credit factors, relevant for the type of exposures under consideration.

184. The EL_{BE} should be estimated on the basis of the long-run average LGD, referred to in paragraph 180 and no further adjustments to reflect current economic conditions should be performed where any of the following conditions is met:

- (a) the model includes directly at least one macroeconomic factor as a risk driver;
- (b) at least one material risk driver is sensitive to economic conditions;
- (c) the realised LGD for defaulted exposures, referred to in paragraph 178, is not sensitive to the economic factors relevant for the type of exposures under consideration.

185. Where none of the conditions listed in paragraph 184 is met, institutions should adjust the long run average LGD for defaulted exposures to reflect current economic conditions. In this case institutions should document separately the long-run average LGD for defaulted exposures, referred to in paragraph 180, and the adjustment to current economic conditions.

7.3.2.3 Relation of EL_{BE} to specific credit risk adjustments

186. Where the model used for credit risk adjustments satisfies or can be adjusted to satisfy the requirements for own-LGD estimates set out in Part Three, Title II, Chapter 3, Section 6 of Regulation (EU) No 575/2013, institutions may use specific credit risk adjustments as EL_{BE} estimates.
187. Where specific credit risk adjustments are assessed individually for a single exposure or a single obligor, institutions may override the EL_{BE} estimates based on specific credit risk adjustments, where they are able to prove that this would improve the accuracy of the EL_{BE} estimates and that the specific credit risk adjustments reflect or are adjusted to the requirements set in section 6.3.1 on the calculation of economic loss.
188. For the purposes of justifying situations where the specific credit risk adjustments exceed the EL_{BE} estimates in accordance with Article 54(2)(f) of the RTS on IRB assessment methodology, institutions should ensure consistency of the EL_{BE} estimates with the economic loss components described in section 6.3.1 as well as with the definition of default set out in Article 178 of Regulation (EU) No 575/2013 and analyse any differences in that regard from the definitions and methods used for the purpose of determining specific credit risk adjustments. In particular, institutions should take into account, the possible differences in the discounting rate, the presence of collateral that is not eligible under Article 181(1)(f) of Regulation (EU) No 575/2013, different treatments of costs and the application of different definitions of default.

7.3.3 Specific requirements for LGD in-default estimation

189. For the purpose of considering the possible adverse change in economic conditions during the expected length of the recovery processes referred to in Article 54(2)(a) of the RTS on IRB assessment methodology the LGD in-default should reflect at least downturn conditions, where the estimates of LGD in-default that are appropriate for an economic downturn are more conservative than the long-run average LGD for defaulted exposures, referred to in paragraph 180.
190. For the purpose of Article 181(1)(h) of Regulation (EU) No 575/2013 the LGD in-default should be increased above the level referred to in paragraph 189 where this is necessary to ensure that the difference between the LGD in-default and the EL_{BE} covers for any increase of loss rate caused by possible additional unexpected losses during the recovery period.
191. For the purpose of ensuring that the LGD in-default is higher than the EL_{BE} , or is in exceptional cases equal to the EL_{BE} for individual exposures, in accordance with Article 54(2)(d) of the RTS on IRB assessment methodology institutions should analyse and correct the LGD in-default in those situations where the EL_{BE} was obtained using specific credit risk adjustments, in accordance with paragraph 186, and is above the LGD in-default obtained through direct estimation in accordance with Article 54(1)(a) of the RTS on IRB assessment methodology.
192. To the extent that the reasons for overriding the outputs of EL_{BE} estimation are relevant also to LGD in-default a consistent override should also be applied to the assignment of LGD in-default in such a way that the add-on to the EL_{BE} covers for any increase of loss rate caused by



possible additional unexpected losses during the recovery period in accordance with Article 181(1)(h) of Regulation (EU) No 575/2013.

193. Irrespective of which of the two approaches referred to in points (a) and (b) of Article 54(1)(a) of the RTS on IRB assessment methodology is used for the purposes of estimating LGD in-default institutions should document separately all of the following:

- (a) the break-down of the LGD in-default into its components: the EL_{BE} and the add-on;
- (b) the break-down of the add-on into all of the following components:
 - (i) the downturn conditions component calibrated on the downturn adjustment to the long-run average LGD as specified in paragraph 189;
 - (ii) the MoC component, referred to in section 4.4;
 - (iii) any component covering for potential additional unexpected losses during the recovery period referred to in Article 181 (1)(h) of Regulation (EU) No 575/2013; this component should only be included in exceptional circumstances where the potential additional losses are not sufficiently reflected in the components referred to in points (i) and (ii).

8 Application of risk parameters

194. In the application of the PD or LGD model and where institutions receive new information with respect to a relevant risk driver or rating criterion, they should take this information into account in the rating assignment in a timely manner, in particular by ensuring both of the following:
- (a) that the relevant IT systems are updated as soon as possible and that the corresponding rating and PD or LGD assignment is reviewed as soon as possible;
 - (b) where the new information relates to the default of an obligor, that the PD of the obligor is set to 1 in all relevant IT systems in a timely manner and in accordance with paragraph 108 of the Guidelines on the application of the definition of default under Article 178 of Regulation (EU) No 575/2013.

8.1 Conservatism in the application of risk parameters

195. For the purpose of Article 171(2) of Regulation (EU) No 575/2013 institutions should apply additional conservatism to the outcomes of the rating assignment where any deficiencies are identified related to the implementation of the model in the IT system or to the process of assignment of risk parameters to obligors or facilities in the current portfolio (application of risk parameters), especially when those deficiencies relate to data used in the rating assignment process. They should do so by establishing a framework that consists of the following phases:
- (a) identification of deficiencies of implementation of the model in the IT system or application of risk parameters;
 - (b) specification of the form of conservatism to be applied and quantification of the appropriate level of conservatism;
 - (c) monitoring of the deficiencies and correcting them;
 - (d) documentation.
196. For the purpose of paragraph 195(a) institutions should have a robust process for identifying all implementation and application deficiencies in the assignment process, whereby each deficiency leads to additional conservative treatment in the affected assignment to a grade or pool. Institutions should consider at least the following triggers for additional conservatism:
- (a) missing data in the application portfolio;

- (b) missing updates of financial statements or credit bureau data as referred to in paragraph 59(h);
 - (c) outdated ratings in the application portfolio; where outdated rating should be understood as specified in Article 25(2)(b) of the RTS on IRB methodology;
 - (d) missing ratings, whereby an exposure is considered as being within the scope of application of the IRB model but is not rated by it.
197. For the purpose of paragraph 195(b) institutions should ensure that the occurrence of any of the triggers referred to in paragraph 196 results in the application of additional conservatism to the risk parameter for the purpose of the calculation of risk-weighted exposure amounts. Where more than one trigger occurs, the estimate should be more conservative. The additional conservatism related to each trigger should be proportionate to the uncertainty in the estimated risk parameter introduced by the trigger.
198. Institutions should consider the overall impact of the identified deficiencies and the resulting conservatism at the level of portfolio covered with the relevant model on the soundness of the assignments to grades or pools and ensure that the own funds requirements are not distorted by the necessity of excessive adjustments.
199. For the purpose of paragraph 195(c) institutions should regularly monitor the implementation and application deficiencies and the levels of additional conservatism applied in relation to them. Whenever possible, institutions should take steps to address the identified deficiencies. Following its assessment, the institution should develop a plan to rectify the deficiencies within a reasonable timeframe, taking into consideration the magnitude of the impact on the own funds requirements.
200. For the purpose of paragraph 195(d) institutions should specify adequate manuals and procedure for applying additional conservatism and should document the process applied in addressing implementation and application deficiencies. Such documentation should contain at least the triggers considered and the effects that the activation of such triggers had on the final assignment to a grade or pool, the level of risk parameter and on the own funds requirements.

8.2 Human judgement in the application of risk parameters

201. Institutions may use human judgement in the application of the model in the following cases:
- (a) in the application of the qualitative variables used within the model;
 - (b) via overrides of the inputs of the rating assignment process;
 - (c) via overrides of the outputs of the rating assignment process.

202. Institutions should specify clear criteria for the use of qualitative model inputs and they should ensure a consistent application of such inputs by all relevant personnel and a consistent assignment of obligors or facilities posing similar risk to the same grade or pool as required by Article 171(1)(a) of Regulation (EU) No 575/2013.
203. For the purpose of Article 172(3) of Regulation (EU) No 575/2013 institutions should specify the policies and criteria for the use of overrides in the rating assignment process. These policies should refer both to possible overrides of inputs and outputs of such process and should be specified in a conservative manner such that the scale of conservative overrides should not be limited. In contrast, the scale of potential decreases of the estimates resulting from the model, either by overriding the inputs or outputs of the rating assignment process, should be limited. In applying the overrides institutions should take into account all relevant and up-to-date information.
204. Institutions should document the scale and rationale of each override. Wherever possible institutions should specify a predefined list of possible justifications of the overrides to choose from. Institutions should also store information on the date of override and the person that performed and approved it.
205. Institutions should regularly monitor the level and justifications for overrides of inputs and outputs of the rating assignment process. They should specify in their policies the maximum acceptable rate of overrides for each model. Where those maximum levels are breached, adequate measures should be taken by the institution. The rates of overrides should be specified and monitored at the level of calibration segment. Where there is a high number of overrides institutions should adopt adequate measures to improve the model.
206. Institutions should regularly analyse the performance of exposures in relation to which an override of input or output of the rating assignment process has been performed in accordance with Article 172(3) of Regulation (EU) No 575/2013.
207. Institutions should regularly assess the performance of the model before and after the overrides of outputs of the rating assignment process. Where the assessment concludes that the use of overrides significantly decreased the model's capacity to accurately quantify the risk parameters ('predictive power of the model'), institutions should adopt adequate measures to ensure the correct application of overrides.

8.3 Use of internal ratings and default and loss estimates

208. In accordance with Article 144(1)(b) of Regulation (EU) No 575/2013 and Articles 18 to 21 of the RTS on IRB assessment methodology institutions should use the same estimates of risk parameters for the purpose of own funds requirements calculation and for internal purposes, including risk management and decision-making processes, unless all of the following conditions are met:

- (a) the deviation is justified and appropriate for the specific area of use;

- (b) the deviation does not lead to a change in rank ordering in the assignment of obligors or facilities to grades and pools within a calibration segment other than within each grade or pool;
 - (c) the deviation is due to the use of parameters for internal purposes without consideration of the MoC, without regulatory floors, without downturn adjustment in the case of LGD estimates or is due to the use of a different calibration method, which may entail specifying different calibration segments.
209. For the purpose of paragraph 208 it may also be considered adequate to group continuous risk parameter estimates into homogenous ranks for internal purposes.
210. Where institutions use for internal purposes estimates of risk parameters that are different from those used in the calculation of own funds requirements they should periodically reflect this in their internal reporting to senior management by providing information on both sets of parameters. In any case internal reporting should include all elements specified in Article 189(3) of Regulation (EU) No 575/2013 based on the estimates of risk parameters used for the purpose of calculation of own funds requirements.

8.4 Calculation of IRB shortfall or excess

211. For the purpose of this chapter the difference between, on the one hand, general and specific credit risk adjustments, additional value adjustments and other own funds reductions relating to these exposures and, on the other hand, expected loss amount in accordance with Article 159 of Regulation (EU) No 575/2013 should be considered IRB shortfall, if negative, and IRB excess, if positive.
212. Where the calculation for the overall non-defaulted portfolio referred to in Article 159 of Regulation (EU) No 575/2013 results in an IRB excess, institutions may use this IRB excess to cover for any IRB shortfall from the calculation carried out in accordance with that Article for the overall defaulted portfolio.
213. For the purposes of adding any IRB excess to Tier 2 in accordance with Article 62 (d) of Regulation (EU) No 575/2013, where the calculation referred to in Article 159 of Regulation (EU) No 575/2013 results in an IRB excess for both the defaulted and the non-defaulted portfolio, the sum of those two IRB excesses should be considered and added to Tier 2 in accordance with the limit referred to in Article 62(d) of Regulation (EU) No 575/2013.
214. For the purposes of Article 159 of Regulation (EU) No 575/2013 institutions should not include partial write-offs in the calculation of general and specific credit risk adjustments. However, as per Article 166(1) of Regulation (EU) No 575/2013, the calculation of the expected loss amount for the application of Articles 158 and 159 of Regulation (EU) No 575/2013 should be based on the exposure value gross of value adjustments but net of write-offs.

9 Review of estimates

215. Institutions should specify internal policies for changes of models and estimates of risk parameters used within a rating system. Such policies should provide that changes in the models should be made as a result of at least the following:

- (a) regular review of estimates;
- (b) independent validation;
- (c) changes in the legal environment;
- (d) internal audit review;
- (e) competent authority review.

216. Where material deficiencies are identified as a result of the procedures referred to in paragraph 215 institutions should take appropriate actions depending on the severity of the deficiency and apply a MoC in accordance with section 4.4.3.

217. For the purpose of regular reviews of estimates, institutions should have a framework in place which includes at least the following elements:

- (a) a minimum scope and frequency of analyses to be performed, including predefined metrics chosen by the institution to test data representativeness, model performance, its predictive power and stability;
- (b) predefined standards, including predefined thresholds and significance levels for the relevant metrics;
- (c) predefined actions to be taken in case of adverse results of the review, depending on the severity of the deficiency.

In their regular reviews of estimates institutions may rely on the results of independent validation where such results are up to date.

218. The reviews of estimates to be performed at least annually in accordance with Article 179(1)(c) of Regulation (EU) No 575/2013 should be performed taking into account the metrics, standards and thresholds defined by the institution in accordance with paragraph 217. The scope of such reviews should comprise at least the following elements:

- (a) an analysis of data representativeness, including all of the following:

- (i) an analysis of potential differences between the RDS used to quantify the risk parameter and the application portfolio, including the analysis of any changes in the portfolio or any structural breaks, in the manners of analysing the representativeness described in section 4.2.4;
 - (ii) an analysis of potential differences between the RDS used to develop the model and the application portfolio; for this purpose institutions should:
 - perform the analysis set out in paragraphs 24, 25, and 26;
 - consider that data used for model development is sufficiently representative in terms of points (a) and (b) of paragraph 21 if the performance of the model in the sense of paragraph 218(b) is sound;
 - perform the analysis set out in paragraphs 22 and 23 where the performance of the model in the sense of paragraph 218(b) is deteriorating;
- (b) an analysis of the performance of the model and its stability over time, which should have both of the following characteristics:
- (i) the analysis should identify any potential deterioration of the model performance, including the model's discriminatory power, through the comparison of its performance at the time of the development against its performance on each subsequent observation period of the extended data set as well as against the predefined thresholds; this analysis should be performed on relevant subsets, for instance with and without delinquency status in the case of PD estimates, or for various recovery scenarios in the case of LGD estimates;
 - (ii) the analysis should be performed with regard to the whole application portfolio, without any data adjustments or exclusions performed in model development; for comparison purposes, the performance at the time of development should also be obtained for the whole application portfolio, prior to any data adjustments or exclusions;
- (c) an analysis of the predictive power of the model, including at least:
- (i) an analysis of whether the inclusion of the most recent data in the dataset used to estimate risk parameters leads to materially different risk estimates and in particular:
 - for PD, whether including the most recent data leads to a significant change in the long-run average default rate; this analysis should take into account the appropriate redefinition of the period of likely range of

variability of default rates and of the mix of good and bad years, if necessary;

- for LGD, whether including the most recent data leads to a significant change in the long-run average LGD or downturn LGD;

- (ii) a back-testing analysis, which should include a comparison of the estimates used for the calculation of own funds requirements against observed outcomes for each grade or pool; for this purpose institutions may take into account the results of back-testing performed as part of the internal validation in accordance with Article 185(b) of Regulation (EU) No 575/2013 or they may perform additional tests, for instance with regard to a different timeframe of the dataset.

219. Institutions should specify conditions under which the analyses referred to in paragraph 218 should be performed more frequently than annually, such as major changes in the risk profile of the institution, credit policies or relevant IT systems. Institutions should perform the review of the PD or LGD model whenever they observe significant change in economic conditions as compared with the economic conditions underlying the dataset used for the purpose of model development.

220. For the purpose of performing the tasks referred to in Article 190(2) of Regulation (EU) No 575/2013 institutions should define a regular cycle for the full review of the rating systems, taking into consideration their materiality, and covering all aspects of model development, quantification of risk parameters and, where applicable, the estimation of model components. This review should include all of the following:

- (a) a review of the existing and potential risk drivers and an assessment of their significance based on the predefined standards of review referred to in paragraph 217;
- (b) an assessment of the modelling approach, its conceptual soundness, the fulfilment of the modelling assumptions and alternative approaches.

Where the results of this review recommend changes to model design, appropriate actions should be taken following the results from this analysis.

221. For the purpose of the review specified in paragraphs 217 to 220 institutions should apply consistent policies for data adjustments and exclusions and ensure that any differences in the policies applied to the relevant datasets are justified and do not distort the results of the review.