# Fixes Related to LGD Calculation

## Overview

In SAS Credit Scoring for Banking, there are some discrepancies in how values for LGD variables are calculated. The following sections describe those discrepancies in detail and explain how the hot fix resolves them.

*Note:* The LGD-related changes mentioned in this document are applicable only for LGD models that you create after applying the hot fix. The hot fix does not affect the existing LGD models.

# Incorrect Default-Capture Period for Backtesting, Pooling, and Actual Calculation Processes

In SAS Credit Scoring for Banking, the default-capture period that is considered to identify default events during backtesting, pooling, and actual calculation processes incorrectly refers to a period before the scoring date.

The default-capture period for backtesting, pooling, and actual calculation should start from the scoring date. The hot fix introduces another parameter (CSB\_DEF\_CPTR\_PERIOD\_POST\_LGD\_SCR) to define the default-capture period for backtesting, pooling, and actual calculation processes.

After the hot fix is applied, the default-capture period for a backtesting, pooling, or actual calculation ABT starts from the scoring date and ends after N months (or days). (N is the length of the default-capture period. It is specified by the CSB\_DEF\_CPTR\_PERIOD\_POST\_LGD\_SCR parameter.)

*Note:* The default-capture period for a modeling ABT starts N months (or days) before the ABT build date and ends on the ABT build date. (N is the length of the default-capture period. It is specified by the DEFAULT\_CAPTURE\_PERIOD parameter.) By default, the value of the CSB\_DEF\_CPTR\_PERIOD\_POST\_LGD\_SCR parameter is set to the value of the DEFAULT\_CAPTURE\_PERIOD parameter. You can change the values of these parameters. For more information, see the *SAS Credit Scoring for Banking: Administrator’s Guide*.

*Note:* The hot fix overwrites the create\_event\_data.sas macro. Therefore, if you have made any changes in this macro, you will need to make those changes again after applying the hot fix. This macro now uses the m\_dabt\_abt\_type\_cd macro variable to determine the ABT type (modeling, scoring, pooling, backtesting, or actual calculation).

# Actual LGD Calculation Performed over an Incorrect Period

In SAS Credit Scoring for Banking, the actual calculation process for a scoring run starts from the scoring date and continues for a length of period twice that of the defined recovery period. (Recovery period is defined in the PRODUCT\_RECOVERY\_CONFIG table.) During the actual calculation process, LGD is calculated for all accounts that defaulted in this period, which is incorrect. The LGD calculation considers all recoveries that are made in this period, which is also incorrect.

Ideally, for a scoring run, the actual calculation should start from the scoring date, and it should continue until the recovery period of all defaulted accounts is over. In other words, the actual calculation period for a scoring run should start from the scoring date and continue for a period equal to the length of the default-capture period plus length of the recovery period as defined in the PRODUCT\_RECOVERY\_CONFIG table.

For example, as illustrated in Figure ABC, D1 is the default date of account 1. D2 is the default date of account 2. D1D1’ is the recovery period for account 1. D2D2’ is the recovery period for account 2.

An account that defaults out of the default-capture period is not considered for actual calculation. Therefore, the latest that an account can default and still be considered for actual calculation is the end of the default-capture period (30 Jun 13). The recovery period for such an account is D3D3’. Therefore, the recovery period end date (that is, the end date of the recovery period for the latest possible default in the default-capture period) is 31 Jul 14. Thus, the correct actual calculation period for the scoring run dated 31 Dec 12 starts from 31 Dec 12 and ends on 31 Jul 14.

After you apply the hot fix, the correct actual calculation period is considered for all scoring runs that are performed after the hot fix.

As a result, the model-monitoring reports for a scoring run are updated for the actual calculation period (default-capture period + recovery period).

*Note:* If you are using the DDS to FM ETL (prepackaged with the solution) to populate the foundation mart, and if there are multiple recoveries against a default event in the DDS.Exposure\_Recovery table, the VALID\_TO\_DTTM column should have sufficiently high datetime values (typically, 31Dec4747:23:59:59) for these recoveries. This particularly needs to be checked if there are multiple recoveries for a default event in the same time period, for example, in the same month.

*Note:* At the end of a scoring run, a record is added to the Apdm.Scoring\_Control\_Detail table. The Outcome\_Period\_End\_Dttm column in this table indicates the date of the final actual calculation run for the scoring run. For example, for scoring run dated 31 Dec 12, the Outcome\_Period\_End\_Dttm column contains a value of 31 Jul 14.

# Incorrect Calculation of EAD, Recovery Cost, and LGD

In SAS Credit Scoring for Banking, incorrect default-capture period and recovery period result into incorrect calculation of EAD, recovered amount, and recovery cost. As a result, LGD is also calculated incorrectly.

EAD for a credit facility should be the sum of EADs for all accounts that are linked with that credit facility. However, currently, of all the accounts associated with a credit facility, the EAD of the account with the earliest default in the default-capture period is the EAD of the credit facility.

Ideally, during backtesting, pooling, or scoring, only non-default accounts should be considered for variable calculation. Then, it should be observed whether those accounts default in the default-capture period, which starts from the scoring date. For accounts that default, EAD, recovered amount, and recovery cost should be calculated with reference to the respective date of default. Recoveries should be calculated in the recovery period, which starts from the date of default. Any recovery that is made out of the recovery period should not be considered for actual LGD calculation. Any account that defaults out of the default-capture period should not be considered as default, and hence LGD should not be calculated for that account.

Currently, the values for the variables are calculated according to their current definitions. Depending on the definition of a variable, its value is derived from one of the following tables:

* Inpbase.Account\_Default\_Dim
* Inpbase.Account\_Def\_Rec\_Base\_Act
* Inpbase.Account\_Default\_Recovery\_Base
* Inpbase.Credit\_Facility\_Default\_Dim
* Inpbase.Crd\_Fac\_Def\_Rec\_Base\_Act
* Inpbase.Credit\_Fac\_Def\_Recovery\_Base

The hot fix resolves these issues by introducing a macro (csbmva\_ext\_calc\_lgd\_var) to calculate the values for these variables.

After the hot fix is applied, the values of the variables are still calculated as they were calculated before the hot fix was applied. However, after the hot fix is applied, during the last step of the ABT building process, the original values of the variables are overwritten by the values calculated by the csbmva\_ext\_calc\_lgd\_var macro. This macro derives the values directly from the following foundation mart tables: Dim.Default\_Event\_Dim and Fact.Recovery\_Fact. For more information about how these variables are calculated, see “[Calculating LGD](#_Calculating_LGD).”

The CSB\_UPDT\_LGD\_POST\_BUILD\_FLG parameter determines whether the original values of the variables are overwritten. The default value of the parameter is Y.

If you do not want to overwrite the original values, change the value of the CSB\_UPDT\_LGD\_POST\_BUILD\_FLG parameter to N. For example, if you have customized how you calculate LGD values and you want to retain that customization even after applying the hot fix (that is, you do not want to overwrite the values with those calculated by the csbmva\_ext\_calc\_lgd\_var macro), you can change the value of the CSB\_UPDT\_LGD\_POST\_BUILD\_FLG parameter to N. For more information about the CSB\_UPDT\_LGD\_POST\_BUILD\_FLG parameter, see the *SAS Credit Scoring for Banking: Administrator’s Guide*.

***Note:*** In the upcoming release (5.4) of SAS Credit Scoring for Banking, these variables will be shipped with the solution as preconfigured external variables. Their values will be calculated by external code. Similar to the csbmva\_ext\_calc\_lgd\_var macro, the external code will derive the values of the variables directly from the following foundation mart tables: Dim.Default\_Event\_Dim and Fact.Recovery\_Fact. This will bypass an extra layer of ETL of Inpbase library tables. This approach (using SAS code to derive values for LGD variables directly from the foundation mart tables) will give you the flexibility to customize the variable calculation logic.

# Incorrect Target Population for Backtesting and Pooling ABTs

Ideally, implicit filters should ensure that the target population for backtesting, pooling, and scoring processes contain only non-default accounts. Also, the target population for a modeling process should contain both default and non-default accounts. However, currently, modeling as well as backtesting and pooling processes consider both default and non-default accounts.

To ensure that the target population for a backtesting ABT contains only non-default accounts, the backtesting ABT should use the implicit filters that are defined for the scoring ABT. The hot fix ensures this by updating the configuration of the implicit filters that are associated with backtesting ABTs. This update is made in the Apdm.Implicit\_Subset\_Spcfctn\_Dtl table.

In SAS Credit Scoring for Banking 5.1, a pooling ABT uses implicit filters that are associated with the modeling ABT. To ensure that the target population for a pooling ABT contains only non-default accounts, the pooling ABT should use the implicit filters that are defined for the scoring ABT.

The hot fix ensures this by changing the process that is used to build the pooling ABT. The hot fix makes the pooling ABT building process similar to the backtesting ABT building process. Hence, similar to the backtesting ABT, the pooling ABT also uses implicit filters that are associated with the scoring ABT.

*Note:* These changes are applicable for only those projects that you create after applying the hot fix. The hot fix does not affect the backtesting and pooling ABTs in existing projects.

# Calculating LGD

## Overview

LGD is derived from three other variables: EAD, recovery cost, and recovered amount. The hot fix introduces the csbmva\_ext\_calc\_lgd\_var macro to calculate the values for these variables.

## Identifying Default Events and Reference Dates for LGD Calculation

### For Accounts

An account or credit facility can have multiple default events associated with it. However, only the default events where default status has the value of the DEFAULT\_STATUS\_CD parameter are considered for LGD calculation. Throughout this topic, defaults (or default events) mean default events where default status has the value of the DEFAULT\_STATUS\_CD parameter.

SAS Credit Scoring for Banking checks for default-events in the default-capture period. When a default-event for an account is found, the date of that default event is used as the reference date for calculating the EAD, recovery cost, and recovered amount for that account. If an account has multiple default events in the default-capture period, the date of the latest default event is used as the reference date.

Then, the following formula is used to calculate the LGD:

LGD (in percent) = (EAD + Recovery cost – Recovered amount)/EAD

*Note:* An account that defaults in the default-capture period is treated as default even if it becomes active in the same period. Default events before or after the default-capture period are not considered. For example, if an account entered the default-capture period with a default status and remained defaulted throughout the default-capture period, or became active and remained so throughout the period, then the associated default event is not considered for LGD calculation. That is because the date of default is before the default-capture period and not in the default-capture period.

For more information about default-capture period, see “[Incorrect Default-Capture Period for Backtesting, Pooling, and Actual Calculation Processes](#_Incorrect_Default-Capture_Period).”

The calculation logic in the csbmva\_ext\_calc\_lgd\_var macro is based on certain assumptions related to the records in the DDS.DEFAULT\_EVENT table (or the corresponding dim.DEFAULT\_EVENT\_DIM table):

* At a given point in time, an account can have multiple valid default events. However, at a given point in time, an account must have only one default event with default status indicated by the *DEFAULT\_STATUS\_CD parameter*.
* For an account, each default event must have a unique default date.
* The date of a default event does not change over time.

### For Credit Facilities

Note: The csbmva\_ext\_calc\_lgd\_var macro supports LGD processing for credit facilities with the assumption that if one account associated with a credit facility defaults, all the accounts associated with that credit facility are marked as defaults. In other words, the macro assumes that the DDS.DEFAULT\_EVENT table (or the Dim.DEFAULT\_EVENT\_DIM table, if you are using custom-built ETL) has records in accordance to the fact that all accounts associated with a credit facility have a different default event with the same status (indicated by the DEFAULT\_STATUS\_CD parameter) and default date.

A credit facility is said to have defaulted if its accounts have default events in the default-capture period. A default event is identified for each account that is associated with the credit facility. Then, EAD, recovery cost, and recovered amount are calculated for each account with reference to the date of default.

## Calculating EAD

### For Accounts

For an account, EAD corresponding to its identified default event is fetched from the Dim.Default\_Event\_Dim table.

*Note:* It is assumed that EAD does not change over a period of time. Even if it does, the csbmva\_ext\_calc\_lgd\_var macro considers the EAD as of the date of default.

### For Credit Facilities

EAD for a credit facility is the sum of the EADs for all accounts associated with that credit facility. For each account, EAD is calculated with reference to the date of the identified default event for that account.

## Calculating Recovered Amount and Recovery Cost

### For Accounts

Recovered amount is the total amount that is recovered from a defaulted account during the recovery period. Recovery cost is the total amount that is invested to recover the dues from the account during the recovery period. Both of these values are calculated with reference to the date of the identified default event for that account.

Recovery period for a defaulted account starts from the date of default and ends at the recovery period end date. For more information about recovery period, see “[Actual LGD Calculation Performed over an Incorrect Period](#_Actual_LGD_Calculation).”

Recovered amount and recovery cost are calculated by aggregating data (in the Fact.Recovery\_Fact table) pertaining to the recovery period. Recovery period end date is identified based on the recovery period. For example, if recovery period (and adjustment period) is 13 months, then the recovery period end date is the date that occurs 13 complete calendar months after the date of default. The following table shows some sample default dates and the corresponding recovery period.


### For Credit Facilities

Recovered amount for a credit facility is the sum of the recovered amounts for all accounts associated with that credit facility. Recovered cost for a credit facility is the sum of the recovered costs for all accounts associated with that credit facility. For each account, these values are calculated with reference to the date of the identified default event for that account.

# Fixes Related to PD and LGD Models’ Actual Value Updates

Currently, for PD and LGD models, the actual values, feeds, and measures are calculated incorrectly. After you apply the hot fix, these values are correctly calculated for the subsequent scoring runs.

*Note:* For a model’s scoring runs for which the outcome period is still not over, the actual values will be calculated as you load the subsequent scoring data for the model. For scoring runs for which the outcome period is already over, the actual values will not be updated. You can check the CSBFACT.MODEL\_SCORE\_SUMMARY table for scoring dates and outcome periods.

# Fixes Related to CCF Models’ Actual Value Updates

Currently, target period for CCF models is set incorrectly. As a result, the actual values for CCF models are calculated incorrectly.

After you apply the hot fix and perform the following steps, target period for CCF models is set correctly.

For each CCF model for which the scoring data load was already complete (before the hot fix was applied), perform the following steps after applying the hot fix:

1. Specify an outcome period for each CCF model in the OUTCOME\_PERIOD\_CNT column of the APDM.SCORING\_MODEL table. Specify the outcome period in months or days, depending on the grain of your foundation mart.
2. Set the value of the OUTCOME\_PERIOD\_TIME\_FREQ\_SK column in the APDM.SCORING\_MODEL table to the value of the TIME\_FREQUENCY\_SK column of the APDM.TIME\_FREQUENCY\_MASTER table. The preconfigured values are 1 (for month) and 2 (for day).
3. Set the value of the OUTCOME\_PERIOD\_END\_DTTM column in the APDM.SCORING\_CONTROL\_DETAIL table to the sum of the values in the SCORING\_AS\_OF\_DTTM and SCORING\_MODEL.OUTCOME\_PERIOD\_CNT columns.
4. Set the value of the TARGET\_TIME\_SK column in the CSBFACT.MODEL\_SCORE\_SUMMARY table to the sum of the values in the SCORE\_TIME\_SK and SCORING\_MODEL.OUTCOME\_PERIOD\_CNT columns.
5. Set the value of the TARGET\_PERIOD\_CNT column in the DIM.ANALYTICAL\_MODEL\_DIM table to the value of the SCORING\_MODEL.OUTCOME\_PERIOD\_CNT column.
6. Set the value of the TARGET\_PERIOD\_TIME\_FREQ\_CD column in the DIM.ANALYTICAL\_MODEL\_DIM table to Month or Day, depending on the grain of your foundation mart.

*Note:* For a model’s scoring runs for which the outcome period is still not over, the actual values will be calculated as you load the subsequent scoring data for the model. For scoring runs for which the outcome period is already over, the actual values will not be updated. You can check the CSBFACT.MODEL\_SCORE\_SUMMARY table for scoring dates and outcome periods.

# Fixes Related to Application Scoring Models

## Overview

In SAS Credit Scoring for Banking, there are some discrepancies in how statistical measures are calculated for application scoring (PDA) models. The following sections describe those discrepancies in detail and explain how the hot fix resolves them.

The “Development Data Details” section lists the precaution that you must take when importing development data details for application scoring models.

# Model-Monitoring Measures

During the scoring process, the System Stability Index measure is calculated based on only the accepted applications, which is incorrect.

After you apply the hot fix, all the applications, including both the accepted and rejected applications, are considered when calculating the System Stability Index measure.

For model-monitoring reports, proportion of goods is derived at run time during measure calculation. The proportion of goods in a bin is calculated as follows:

Proportion of goods in a bin = Number of goods in the bin / Total number of goods in all bins

Where, the number of goods in a bin is calculated as follows:

Number of goods in a bin = Number of accepted applications in the bin - Number of bads in the bin

# Model-Input-Monitoring Measures

During the scoring process, the following model-input-monitoring measures are calculated based on all the applications, which is incorrect. After you apply the hot fix, only the accepted applications are considered when calculating these measures.

* Event Stability Index
* Event Shift Index
* Gini Index
* Information Value Statistic
* Pearson's Chi-Square (p-value)
* Attribute Event Rate by Score
* Kolmogorov-Smirnov Statistic

For model-input-monitoring reports, the proportion of goods is calculated at a variable’s attribute level.

Proportion of goods in an attribute range = Number of goods in the attribute range / Total number of goods in all attributes of the variable

Where, the number of goods in an attribute range is calculated as follows:

Number of goods in an attribute range = Number of accepted applications in the attribute range - Number of bads in the attribute range

*Note:* This fix is applicable only for the scoring data load that you perform after applying the hot fix. The hot fix does not correct the existing scoring data in the credit scoring mart. If you want to correct the existing data in the credit scoring mart, you must delete the data and load it again after you apply the hot fix.

# Note about SAS Credit Scoring for Banking User

A SAS Credit Scoring for Banking user must be a member of the SAS General Servers user group. Or, make sure that a password is specified for the user. To check whether a password is specified for a user, perform the following steps:

1. In SAS Management Console, expand **Plug-ins** 🡪 **User Manager**.
2. In the right pane, right-click the user, and then select **Properties**.
3. In the User Properties dialog box, check the **Accounts** tab.