EAST WEST BANK

Model Performance Monitoring Plan for CECL Models

Version 3.2

Fall 2024

Modeling and Allowance Analysis

Contents

1 Overview of Model Performance Plan

The Bank currently utilizes Moody's CMM, Moody's MPA, and C&I Loss Rates Model (in-house model) to produce CECL lifetime allowance predictions for the commercial real estate portfolios (including MFR, construction, and land), the residential mortgage portfolios (including SFR and HELOC), and C&I portfolio, respectively.

ASC 326-20-35-2 prescribes that we should evaluate whether a financial asset in a pool continues to exhibit similar risk characteristics with other financial assets in the pool. For example, there may be changes in credit risk, borrower circumstances, recognition of write-offs, or cash collections that have been fully applied to principal on the basis of nonaccrual practices that may require a reevaluation to determine if the asset has migrated to have similar risk characteristics with assets in another pool, or if the credit loss measurement of the asset should be performed individually because the asset no longer has similar risk characteristics.

Federal Reserve Board SR Letter 11-7 and Office of the Comptroller of the Currency Bulletin OCC 2011-12 provide regulatory guidance around model risk frameworks for validations to confirm that the model(s) is appropriately implemented and is being used and performing as intended. It is essential to evaluate whether changes in products, exposures, activities, clients, or market conditions necessitate adjustment, redevelopment, or replacement of the model and to verify that any extension of the model beyond its original scope is valid.

Lastly, East West Bank Model Risk Management Policy MRM-PnP01, Section N - Ongoing Model Performance and Risk Monitoring (CONTROL 9), requires model owners to ensure that model ongoing performance and risk monitoring plans are developed, documented, and carried out for each model registered in the Model Inventory regardless of the model's Inherent Risk Rating. Monitoring plans should generally cover:

1. Model Ongoing Performance Monitoring – Analysis of the model's ongoing performance using appropriate metrics and thresholds along with appropriate action plan should there be a threshold breach; and
2. Model Risk Monitoring – Review of model weaknesses and limitations, associated risk mitigants, and tracking of model overlays, overrides, and adjustments.

This plan combined with the annual review performed by the Bank are set forth to accomplish these requirements.

Ongoing Performance monitoring is critical to management's ability to track to the model's (CI, CMM and MPA) continued performance and fit for their intended use. The Model Performance Monitoring Plan ("MPMP") and ongoing performance monitoring serve as a tool to measure performance of the model to determine if they continue to perform as expected. The ACL Memo and Annual Review Memo present the details of the quarterly results, assumptions, and methodologies of the modeled results.

The steps involved in the design of the MPMP include clear and agreed activity objectives; designing appropriate indicators and measurements at the appropriate stages of the model performance to those goals; setting performance measure targets and baselines, and performance evaluations; defining roles and responsibilities; developing quality control mechanisms and data collection processes; establishing reporting schedules; and identifying and managing risks.

The MPMP is a dynamic and flexible document that will be updated throughout the year. Existing targets will be reviewed to assess their continued relevance, and new targets will be incorporated based on activity performance and results, and changes in the modeling expectations.

These Ongoing Monitoring processes described below are reviewed by MRM.

1.1 Results Framework

The set of performance metrics, detailed in the subsequent sections, are designed based on the model types and availability of production data. The metrics described have specific thresholds that define an acceptable performance range. Through periodic ongoing monitoring efforts coupled with the quarterly production of the overall ACL process, Management would be able to evaluate whether the model requires adjustments through recalibration, re-development, or management overlay to cover the models' inherent risks. Finally, the appropriate governance structure is in place to review the model performance and conclusions.

The following are the models being evaluated:

- Moody's CMM – Expected Loss, Probability of Default, Loss Given Default
- Moody's MPA – Expected Loss, Probability of Default, Probability of Prepayment, Loss Given Default
- C&I Custom Lifetime Loss Rate (in-house model) – Expected Loss

Escalation Process and Plan: The performance monitoring statistical metrics are classified into three categories. They are aimed to identify the severity level of the model issues and follow the escalation plan to resolve them accordingly.

Assessment Outcome	Escalation Plan
Good	Assessment indicates satisfactory performance. No further action is required.
Acceptable	Assessment indicates acceptable performance. There could be opportunity for model owner to perform additional analysis. Depending on the nature of the test measure (see the individual performance indicator detail), this could indicate early signs of model weakness. Further investigation may be required
Weak	Assessment indicates poor performance. Root cause investigation is required when appropriate. Based on the outcome of the analysis, depending on the nature of the test measure, management will determine the most appropriate mitigation plan, including recalibration or re-development if warranted

Testing periods: The primary purpose of the Ongoing Monitoring is to assess performance of the models as they are being used in the production environment. The Bank implemented these models in January 2020 for CECL; hence, there is only limited data accumulated for any meaningful statistical tests.

- Quarterly production data that spans the monitoring horizon (typically one year, but may be cumulative from Q1 2020 onwards)
- If appropriate, we may consider aggregating the model development/calibration data to construct a longer time series (for example to monitor Expected Loss)

Testing samples: Test will be performed for the following portfolios as applicable to the sub-models:

- CMM: CRE (by property type)/MFR/Land/Construction
- MPA: ARM SFR/FRM SFR/HELOC
- C&I: Facility-level data

2   Model Performance Classifications

2.1   Expected Lifetime Loss (C&I, CMM, and MPA)

This is applicable to C&I loss rate model, CMM expected loss model and MPA expected loss model.

The purpose is to assess the accuracy of prediction level of expected loss rate (after applying multipliers for CMM and MPA).

Model Performance Indicator	Purpose
Prediction Error	Assess the error in model prediction
Root Mean Squared Error	Assess the movement of prediction errors

2.2   Probability of Default (CMM and MPA)

Probability of default model is part of Moody's CMM and MPA models. The statistical tests aim to assess the predictive and separation power of the models.

Model Performance Indicator	Purpose
Accuracy Ratio	Assess the model's discriminatory power
Kolmogorov-Smirnov Statistic	Assess the model's separation power

2.3 Probability of Prepayment (MPA)

Probability of prepayment model is part of Moody's MPA model. The statistical tests aim to assess the predictive and separation power of the models.

Model Performance Indicator	Purpose
Accuracy Ratio	Assess the model's discriminatory power
Kolmogorov-Smirnov Statistic	Assess the model's separation power

2.4 Loss Given Default (CMM and MPA)

LGD model is an integral part of Moody's CMM and MPA models. The current approach to monitor the LGD is to compare the actual loss rate to the model predicted LGD for the defaulted population. Given the limited data points, we do not perform any additional statistical tests for LGD.

2.5 Input data (C&I, CMM, and MPA)

We will monitor how much an input variable has shifted in distribution over time when compared to the benchmark. Although a significant distributional shift itself may not indicate any potential weakness in the overall model performance, it is a useful measure to supplement the diagnosis when other statistical metrics signal a clear deterioration of model performance.

Model Performance Indicator	Purpose
Population Stability Index	Assess the distribution shift in the test population

3 Model Performance Indicators

The following metrics may be used to test the applicable models/sub-models noted within each metric description. The criteria presented below are subject to change depending on the model and refinement.

3.1 Prediction Error (PE) and Root Mean Squared Error (RMSE)

PE is a measure of how well the model predicts the response variable, in this case the baseline lifetime loss rates. It measures the difference between predicted lifetime loss rate and actual loss rate. **RMSE** similarly measures the magnitude of the prediction error. RMSE is standard deviation of the prediction error for unbiased estimation.

$$RMSE = \sqrt{average\ over\ entire\ time\ period\ of\ (PE^2)}$$

The criteria of RMSE can be model and business specific. However, assuming normal distribution of error, RMSE can be used to set up confidence interval ("CI") to assess if the prediction error may be too large. Given the nature of lifetime loss, in theory, we won't be able to truly assess the prediction error until each loan has gone through its life (or defaulted). Clearly that would not be feasible. With the focus of monitoring in-use (production) data, management is comfortable setting confidence intervals at 95% for assessing potential model deterioration.

The prediction error criteria are defined in the following table.

Assessment Outcome	Target[1]	Resulting Action
Good/Acceptable	-1.96*RMSE =< PE <= 1.96*RMSE (PE within 95% CI)	No action required
Weak	-1.96*RMSE < PE > 1.96*RMSE	Root cause investigation may be required to assess if the large prediction error is still within acceptable range from management perspective

For the RMSE, the entire time series is used, leveraging historical data sample used for model re-development/calibration. Since we are using quarterly data, this approach ensures that the sample size is large enough for the test measure.

3.2 Accuracy Ratio (AR) and Area Under the ROC Curve (AUC-ROC)

Accuracy Ratio and Area under the Receiver Operating Characteristics Curve are statistically equivalent measures that determine the discriminatory power of a classification model. Probability of Default and Prepayment models belong to this category.

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[1] 1.96 is the Z-score corresponding to the 95% confidence interval.
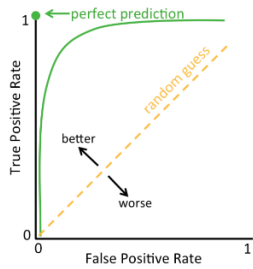
The ROC Curve is a graph with the False Positive Rate (1-Specificity) on the x-axis and the True Positive Rate (Sensitivity) on the y-axis plotted across the range of threshold probability values. The closer the ROC curve follows the y-axis, the larger the area under the curve, and thus the more accurate the model. A random guess would result in a point along the yellow diagonal line from the left bottom to the right corner.

The area under the ROC curve is expressed by AUC-ROC ("AUC" in short). AUC ranges from 0 to 1. If AUC is equal to 0.5, it indicates that a model's predictive power is same as a random model; if AUC is equal to 1, it indicates that a model predictive power is 100%, a perfect model.

Accuracy Ratio is a ratio of the area above and under the cumulative accuracy profile of the model versus a perfect model. AUC and AR are equivalent with following relationship: AR = 2*AUC -1. For reporting purpose, we will use AR.

Assessment Outcome[2]	Criteria	Resulting Action
Good	AUC > =0.7 (AR >= 0.4)	The model has good discriminatory power. No follow-up action required
Acceptable	0.7 > AUC >= 0.6 (0.4 > AR >= 0.2)	The model shows acceptable discriminatory power. As this test is run on the vendor models (CMM PD, MPA PD, MPA PP), it is beneficial to cross reference the monitoring reports from Moody's to compare the outcome. If similar outcome is noted by Moody's, then no further action is necessary
Weak	AUC < 0.6 (AR < 0.2)	The model shows weak discriminatory power. As this test is run on the vendor models (CMM PD, MPA PD, MPA PP), it is beneficial to cross reference the monitoring reports from Moody's to compare the outcome. If similar outcome is noted by Moody's, then no further action is necessary. If, however, the outcome is weaker compared to Moody's assessment, then root cause investigation should be conducted

To ensure the test measures are statistically meaningful, we would only perform the test if the number of defaults are greater than or equal five.

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[2] Applicable if #defaults >= 5

3.3 Kolmogorov-Smirnov (KS) Test

KS is a statistical measure of separation power of a model for binary classification, such as default model (default vs. non-default) and prepayment model (prepaid or not). Typically, a predictive model will generate a probability between 0 and 1, for example, for a default or non-default problem. KS statistics measures the best point at which the sample should be considered as default.

KS ranges from 0 to 1. A model is considered as acceptable if KS > 0.2.

Assessment Outcome	Criteria	Resulting Action
Good	KS >= 0.2	The model has good discriminatory power. No follow-up action required
Acceptable	0.2 > KS >= 0.1	The model shows acceptable discriminatory power. As this test is run on the vendor models (CMM PD, MPA PD, MPA PP), it is beneficial to cross reference the monitoring reports from Moody's to compare the outcome. If similar outcome is noted by Moody's, then no further action is necessary
Weak	KS < 0.1	The model shows weak discriminatory power. As this test is run on the vendor models (CMM PD, MPA PD, MPA PP), it is beneficial to cross reference the monitoring reports from Moody's to compare the outcome. If similar outcome is noted by Moody's, then no further action is necessary. If, however, the outcome is weaker compared to Moody's assessment, then root cause investigation should be conducted

3.4 Population/Characteristic Stability Index (PSI/CSI)

The population stability index (PSI) is used to measure the stability of variables. When PSI is calculated for the independent variables, it is known as characteristic stability index (CSI). PSI/CSI is a metric to measure how much a variable has shifted in distribution over time when compared to the benchmark. It is widely used for monitoring changes in the characteristics of a variable and for diagnosing possible problems in model performance. Although a high PSI or CSI value itself may not indicate any potential weakness in the overall model performance, it is a useful measure to supplement the diagnosis when other statistical metrics (such as Accuracy Ratio for a PD model) signal a clear deterioration of model performance.

The PSI at time t is defined below, instead of counts of loans, percentage of balance are used.

$$PSI(t) = \sum_{bin\ i} (P_i(t) - P_i(t-1)) \ln (P_i(t)/P_i(t-1))$$

Where $P_i(t)$ is percent of balance for bin i, while $P_i(t-1)$ is the percentage of balance for bin i for the reference sample. Typically, for an internally built statistical model that reference sample would be the model development sample. For those models that are not internally built, time t-1 may refer to the current time minus 1 year. Since CMM and MPA are off-the-shelf Moody's models (albeit with EWB EL multipliers), it does not make sense to use the actual model development sample as the benchmark. Hence, we have chosen to use the portfolio data of the previous year to assess population shifts.

Assessment Outcome	Criteria[3]	Resulting Action
Good	PSI <= 0.10	Insignificant population shift. No action required
Acceptable	0.10 < PSI <= 0.25	Minor population shift. If the PSI trend has been stable, then no further action is necessary
Weak	PSI > 0.25	Significant shift in population. Root cause investigation required if the significant PSI increase is noted for the first time. (For C&I model, since the benchmark is the static model development sample, it is reasonable to assume that certain portfolio risk drivers would drift with the progression of time. Thus, the model owner should recognize this aspect as part of the additional analysis.)

It is not typical that we test PSI on the outcome variables[4]. Given the nature of the predicted lifetime loss, it is expected that the loss rate will be subject to change given the changes to portfolio and macroeconomic forecasts.

4   Management of Performance Monitoring – Roles and Responsibilities

AAG is responsible for reviewing, collaborating on research with modeling and other teams, and documenting conclusions. Modeling team is responsible for performance of the monitoring tests and maintenance of the performance monitoring plan.

Implementing the Performance Plan

At the start of the plan year, the modeling team will be the primary group responsible for implementing the plan reported here.   AAG is responsible for reporting, documenting, and overseeing general

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[3] The PSI thresholds are industry standard. Refer, for instance, to: Yurdakul B and Naranjo J, "Statistical Properties of Population Stability Index", USAA and Western Michigan University

[4] For CMM model, the model input variables DSCR and LTV are both derived based on Net Operating Income (NOI) and the property's market value in relation to mortgage payments and balance. As a result, they tend to fluctuate with the market forecasts. Thus, we do not subject the CSI outcome of DSCR and LTV to the Assessment thresholds.

monitoring and evaluation approaches, practices, and tools. The modeling team also cooperates with AAG on the technical level, ensuring that indicators and information are reported as needed by model governance groups.

Information and Data Management

With reference to this plan AAG supports the efforts to maintain a performance monitoring information with the modeling team that holds performance indicator including data collected related to the performance monitoring plan. The modeling team will provide training-related information to AAG, and governance team as requested on the performance indicators and tests.

Data quality is reviewed quarterly through the production process. Data input validations are performed to ensure that missing, unusual or inaccurate data is corrected in a timely manner. Additionally, loan servicing, DMI and other departments which are the source of much of the data quality process follow their own controls to ensure that the data is accurate.

For example, a Loan Accounting Manager reviews the data reconciliations to ensure the data is complete and matches to the general ledger. The accuracy of the loan level data relies on the automated process of movement of data between the Datawarehouse and the DMI environment. A DMI Team Lead will review any exceptions that are identified in the log messages and resolve as necessary. The loan data is automatically uploaded from the servicing systems (FIS, LPS, etc.) into the Datawarehouse daily.

Reporting

The AAG and modeling teams are jointly in charge of producing performance monitoring reports on time, and in a technically valid, high-quality, and policy-relevant manner, with the purpose of providing firm grounds for management decisions. AAG is responsible for developing the protocols and standard procedures to ensure that data is gathered in a technically sound manner, is consistent and can be compared throughout the years. AAG must make judgments with respect to whether or not data meets quality standards.

Governance

The ACL Committee will have responsibility for overseeing the performance monitoring, assuring that the work of the teams meets overall project goals. The Committee will assure that our documentation and conclusions are policy- and decision-relevant to proper governance over the models.

Change Management

The models are reviewed through our Ongoing Model Performance Monitoring and changes to the models go through a robust review process beginning with reviewing the data set and ending with performance testing the key risk drivers and model output. All the key stakeholders review material changes to the model. Each model change is accompanied by model documentation and analysis of the changes to data and performance.

Escalation Process

AAG must identify the severity level of the model issues, and follow the escalation plan to resolve them accordingly, with proper guidance from management and the modeling team.

5   Performance Reporting and Validation Schedule

Performance Reporting

Per SR 11-7, the Bank will conduct a periodic review, at least annually, but more frequently if warranted, of each model to determine whether it is working as intended and if the existing validation activities are sufficient. Our determination could simply affirm previous validation work, suggest updates to previous validation activities, or call for additional validation activities.

If the results of a periodic review are unsatisfactory, it may trigger a full revalidation prior to the next validation date established based on the risk rating of the model and the model risk management policy. If the results of a periodic review are satisfactory, the continued use of the model is appropriate, and the timing of the next full revalidation remains unchanged (unless a triggering event occurs subsequent to the periodic review).

 Generally, a periodic review includes an assessment of the following:

- Performance of the model;
- Changes to the model and updated model development documentation if changes have occurred;
- Changes in the manner in which the model is used or will be used;
- Changes in business or industry practices as they relate to the model;
- Changes that may affect the risk rating of the model; and
- Validation, regulatory, audit, or other oversight issues related to the model that are still open and have not been fully addressed.

AAG will produce reports at least annually on the results of the performance monitoring testing performed by the modeling team. AAG will collate and update the performance data and review this with management and the ACL Committee at minimum during annual review.

The testing period will focus on the CECL production time periods, potentially supplemented by additional historical time periods used during model development to ensure the stability of model performance.

Model Validation

Management's risk assessment intends to be dynamic and responsive to both internal and external factors that are updated at least annually, in accordance with SR 11-7.

It is generally expected that models deemed to have the greatest levels of risk are subject to a full model validation on a more frequent basis, and the determination of the frequency is outlined in the design of the control. It is also expected that for those annual periods in which models do not receive a full

validation or limited scope validation, that a periodic review is performed (a formal review of model performance and key model assumptions) to determine if the model continues to remain fit for use or if model validation needs to be performed before the next scheduled validation date. Based on the MRM risk assessment our CECL models are high risk and subject to model validation every two-years (from the date of the last issue report). Annual ongoing monitoring performance monitoring is done to ensure fitness of the models.

This MPMP proposes indicators against each of the expected results or statistical measurements of the models. It also describes the processes that we will use to perform model evaluation throughout the life of the models. Each indicator has a Performance Indicator Table, which includes the indicators and targets for the performance.

The steps involved in the design of the MPMP include clear and agreed activity objectives; designing appropriate indicators and measurements at the appropriate stages of the model performance to those goals; setting performance measure targets and baselines, and performance evaluations; defining roles and responsibilities; developing quality control mechanisms and data collection processes; establishing reporting schedules; and identifying and managing risks. The MPMP is a dynamic and flexible document that will be updated throughout the year. New targets will be incorporated based on activity performance and results, and changes in the modeling expectations.

Triggering events

Management in coordination with Model Risk Management will review the outcomes of the monitoring results which serve as an early indicators of potential model deterioration. Collectively they will determine if a triggering event has occurred and when a model needs to be either recalibrated or redeveloped due to changes in either internal and/or external factors (resulting in the recalibrated or redeveloped model requiring model validation).

Generally, a model will be recalibrated or redeveloped if a triggering event occurs for an existing model. The following may be considered triggering events:

- A material change is made to the model inputs, theory, or code;
- A new use of a model is established that has a significant impact on the business;
- The model is applied to a significantly different population, product, or process;
- Material changes in model performance occur, beyond those expected at the time of validation;
- Significant changes occur in the environment within which the model is being used (e.g., significant economic shifts); and
- Results of validation or regulatory, audit, or other oversight findings related to the model that were not previously identified or considered by the model validator as part of the previous model validation activity.

Appendix A: Roles and Responsibilities End-to-End Process

Exhibit 1: Key Stakeholders and Review Committees End-To-End Roles and Responsibilities
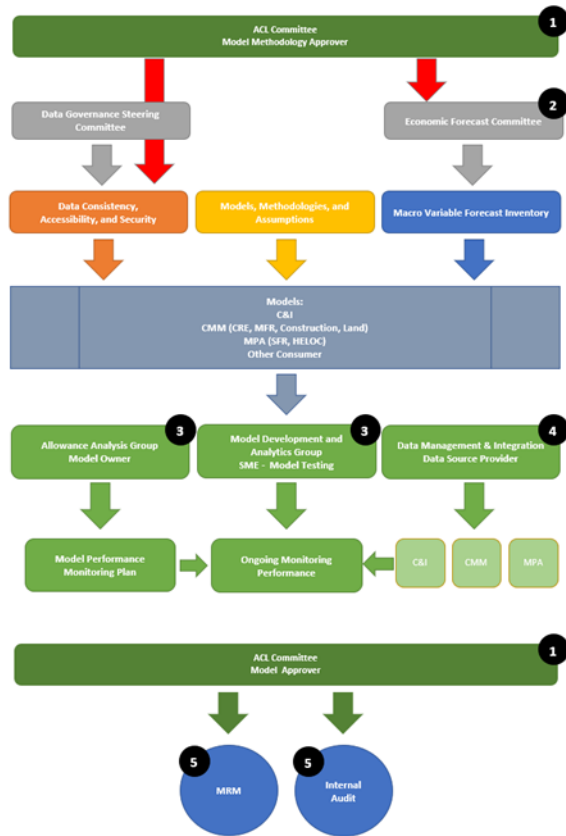
1.　Allowance for Credit Losses ("ACL") Committee

The ACL Committee is a management committee reporting up to the Audit Committee of the Board of Directors. The ACL Committee is responsible for providing oversight of the ACL reserve to ensure that it is appropriately and sufficiently absorbing any potential losses in the Bank's loan portfolios. The Committee ensures that methodologies used to calculate ACL reserve are clearly defined and that the Bank's practices are in compliance with GAAP and other regulatory standards. Model outputs generated through the CECL process will be reviewed by the ACL Committee prior to finalization and reporting. Refer to the *ACL Committee Charter* for further discussion of the Committee's roles and responsibilities and for the most updated list of committee members.

2.　Economic Forecast Committee

The Economic Forecast Committee ("EFC") is a sub-committee of the Asset/Liability Committee ("ALCO"). The EFC oversees the centralized economic forecasting process and provide input and effective challenge to the Company's economic forecasts in order to promote general consistency of economic forecasts used throughout the Company, including economic forecasts utilized for calculating the allowance under CECL, budgeting, capital planning, and disclosures to the investor community. Refer to the *EFC Committee Charter* for further discussion of the Committee's roles and responsibilities and for the most updated list of committee members.

3.　Model Development, Performance Monitoring and Calibration

The model development, performance monitoring and calibration process is owned by both the Model Development and Analytics Group and Allowance Analysis Group ("AAG") with regards to the loan portfolio, and by Treasury with regards to the investment portfolio. This process ensures the soundness of model development, methodologies, and assumptions for ongoing process consistency, repeatability, communication, and expected deliverables.

4. **Data Aggregation and Structural Design**

The data aggregation and structural design process is owned by the Data Management & Integration ("DMI") Team. This process ensures data consistency, accessibility, and security. Responsibilities include the creation of a centralized data dictionary tool and management of a database for CECL models and related disclosure data.

5. **Model Risk Management and Internal Audit**

In addition to the core committees and teams involved in CECL governance processes, the Bank's Model Risk Management ("MRM") and Internal Audit teams are also involved in providing additional lines of defense from a risk management perspective.

Model Risk Management

Model Risk Management is a part of the Bank's Enterprise Risk Management ("ERM") department. As a second line of defense, MRM's roles and responsibilities include sound model governance, policies, controls, robust model development, implementation, use, and effective validation. Through critical analysis and effective challenge, MRM ensures proper management of the Bank's model risk. Refer to the Bank's *Model Risk Management Policy* for further discussion around established standards. (Refer to the *Federal Reserve Board SR Letter 11-7* and Office of the *Comptroller of the Currency Bulletin OCC 2011-12* for regulatory guidance around model risk frameworks).

Internal Audit

The Internal Audit department is responsible for performing monitoring activities in connection with CECL. As a third line of defense, Internal Audit provides management with an independent and objective evaluation of the effectiveness of CECL processes and internal controls. Internal Audit performs testing around model validation, data input review, data aggregation of losses, business unit controls, financial reporting disclosures, and SOX process flow and controls testing.

EAST WEST BANK

Appendix B: Allowance Process Overview
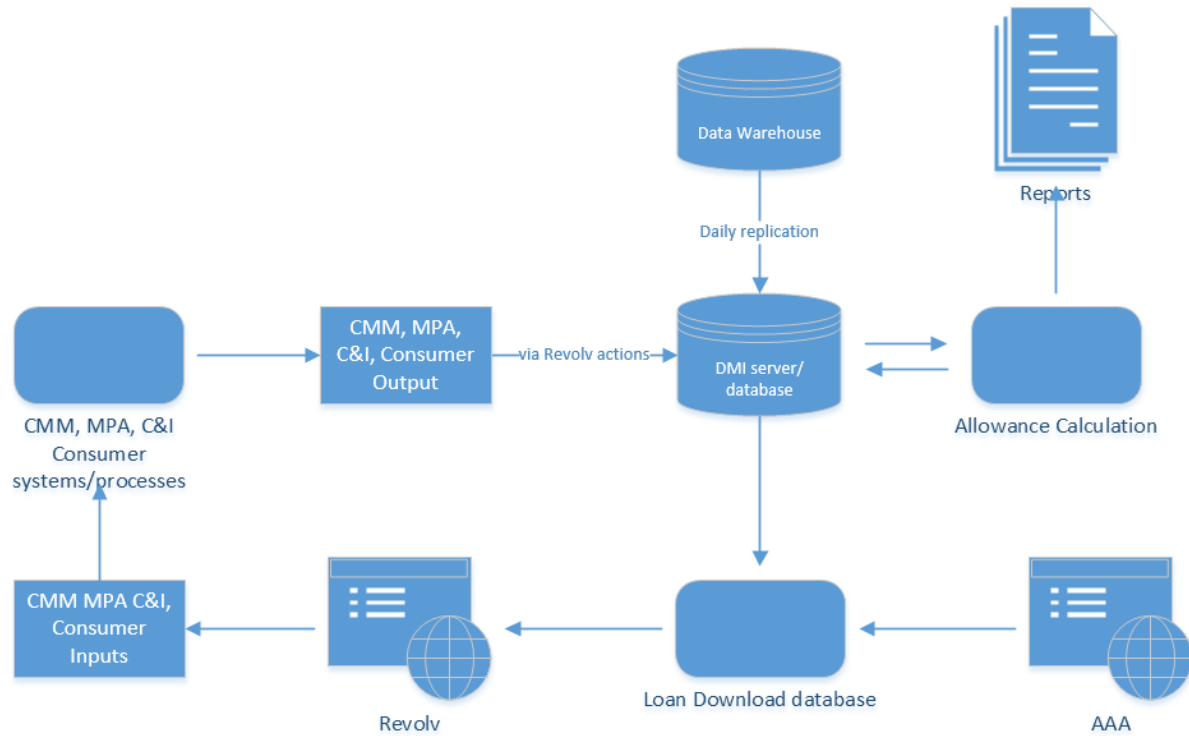
Appendix C: Schedule of Changes

Date	Version	Nature of Revision	Sections Revised	Revised by	Approved by
12/31/2020	1	Initial	All	Paul Ricci	Miriam Galvan
12/31/2021	2			Paul Ricci	Jacqueline Huang
10/31/2022	3	− Renaming the assessment category to better align with model owner interpretation − Minor updates to document format		Jacqueline Huang	
12/5/2023	3.1	- Annual review and minor updates		Jacqueline Huang	
11/15/2024	3.2	- Annual review. Updated the Confidence Interval band	3.1	Nestor Fernandes	Jacqueline Huang