

**Model Documentation for Tier I & Tier II Models**

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| --- | --- |
| **Inventory Name:** | Inventory Name |
| **Inventory ID:** | Inventory ID |
| **Owner:** | Inventory Owner Name |
| **Owner Group:** | Inventory Owner Group |
| **User Groups:** | Inventory User Name |
| **Model Developer:** | Model Developer Supporting the Process |

**Template Guidance**

* Documentation should be guided by the 1st Line of Defense: Model Standards (“Standards”).
* This is a generic template for KeyCorp. The objective is to provide a common structure and a common understanding for the required content to be included.
* Depending on the type of model, certain sections or subsections may not be applicable. However, if a particular subsection does not apply, please explain why it is not applicable.
* Statements and conclusions should be supported with appropriate factual information, including tables, charts and exhibits as necessary. Reference material should be listed and provided in Section 7.
* References to other documents can be used if appropriately cross-referenced and supported.
* **NOTE:** Please remove red text template guidance throughout as documentation is completed.To remove the highlighting in the editable sections after the completion of the template, in the menu bar at the top, please go to the “**Review**” tab, click on “**Restrict Editing**” in the tool bar, and uncheck the box of “**Highlight the regions I can edit**” on the right hand side tool bar that comes up.

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1. **Executive Summary**
   1. **Model Overview**

This section documents a description of the model’s purpose and specific uses. This should include, but not be limited to, the applicable aspects outlined below (sections 1.1.1. through 1.1.10.). The level of information should sufficiently provide parties unfamiliar with the model an understanding of how the model operates. If a particular subsection does not apply, please explain why it is not applicable.

1. ***Intended purpose of the model***

This section should document a brief description of the model purpose consistent with business needs.

1. ***Intended model scope of application for business need***

This section should define the scope of application of the model, ensuring that the scope is aligned with the business needs.

1. **Model uses and users, and role of the model output in the business process**

The scope of application includes designation of specific situations and instances for which the model is used. For example, the model is used as part of a combination of information to make a business decision, or is the primary information for making a business decision, or is used to benchmark only, etc. If the model is used for multiple purposes, such as the model used in both business as usual forecasting and stress testing, two separate uses must be documented. For example, for a PD model, credit underwriting may be identified as a primary use, while economic capital may be identified as a secondary use.

1. **Management actions driven / impacted by the model**

This section documents model’s materiality and potential impact on business decisions, risk appetite statement articulation, dollar impact on relevant financial results, and other relevant metrics

1. **Portfolio sizes / Exposure / Populations / Regions / Products**

This section should document the model scope of application, which may include designation of specific regions, portfolios, time periods and/or products that the model is applicable to, as well as the range of applications for which the model will be used (e.g., economic capital, stress testing, ALLL, credit scoring during the origination and first 6 months of a loan, credit scoring for seasoned loans past 6 months, etc.).

1. ***Applicable regulatory requirements with relevant sections referenced***

This section should describe relevant regulatory requirements that apply to the model and reference the relevant sections of specific regulatory requirements. This section should note any minimum requirements specified in regulatory rules (e.g., forecast horizon of 9 quarters for CCAR loss forecasting models), as well as any legal constraints on the design of a model (e.g., legal restrictions on explanatory variables in PD models).

1. ***Applicable internal policies and procedures with relevant sections referenced***

This section should document any relevant requirements contained in internal KeyCorp policies, standards, procedures that the model is in compliance with, and explain how the internal policies, standards, and procedures define specific requirements in the context of the model being developed rather than generic requirements. Note the relevant sections of the KeyCorp policies, standards, and procedures in this section. For example, a credit policy may call for explicit separation of origination and seasoned behavioral models, which would be incorporated into this section.

1. ***For any model redevelopment, document changes that will address prior model version limitations and issues, including (i) description of prior limitation and (ii) current mitigation***

**This section only applies to the redeveloped models**.

1. **Description of prior limitation**

This section should document identified limitations and outstanding validation and performance issues of the existing models.

1. **Current mitigation**

This section should describe how the new model will address existing issues and limitations. If applicable, document relevant changes in definitions (e.g., product definitions), additional data sources used or considered, planned usage, target population, or underlying business changes since the time that the original model was developed, and explain why additional changes are considered in the new model development processes.

1. ***Requirements of model output, including downstream models, processes and* *reporting***

This section should document existing downstream models, material processes (e.g., underwriting process), and material reports (such as external reports, senior management reports, and Board reports) that will consume the model output. Describe the granularity of output (e.g., loan-level vs. segment-level vs. portfolio-level) and frequency of output (e.g., monthly vs. quarterly vs. annual).

1. ***Process Flow***

This section should document the process flow associated with the model to help the reader understand the business processes the model is associated with, as applicable.

1. ***Model Limitations – Description, Impact (CCAR / other uses), and Mitigating* *Factors***

This section should document model limitations, a description of the associated model risk, and, the risk mitigant(s) designed to address this risk. The limitations to document may include, but are not limited to, the limitations of the selected modeling approach, such as overall robustness and theoretical reasonableness, as well as data limitations. Risk mitigants may include, for example, limits on the model use, adjustments to model outputs and additional governance and review of model results.

If the model has any regulatory impact, i.e. CCAR, BSA/AML, Fair Lending, please document risk mitigant(s) that ensures Key’s compliance with regulatory requirements.

1. ***Primary Model Stakeholders***

This section should document primary model stakeholders including, but not limited to, model owner, model user, model developer, downstream feeder model owner, and related vendor(s).

1. ***Any additional applicable information***

This section should document any model information not covered by the above sections that may deemed pertinent to further understand the model’s purpose and use at Key.

1. **Appropriateness and Integrity of Data**

This section documents the general areas of model risk related to the model development data used to build the models. These are the data used to build, test, and calibrate models, and are distinct from data used in the production setting of a model.

1. 1. **Appropriateness, Completeness, and Accuracy of the Input Data**

This section is designed to document 1st LOD testing expectations regarding the appropriateness, completeness, and accuracy of the data used in model development include, but is not limited to, the objectives outlined below subsections. Please respond to each of the subsections below with a comprehensive summary of the testing performed, results, and conclusions. If a particular subsection does not apply, please explain why it is not applicable.

* + 1. ***Design of the development data, including breadth of cross-section and length of time-series***

This section should document data design to indicate all data and inputs are deemed relevant to the model’s intended use and modeling approach, including:

* Efforts made to collect the universe of data related to the relevant drivers, while also recognizing reasonable constraints on resources (such as financial, human and computational resources) available for data collection, especially in situations where data are scarce or of poor quality.
* Granularity of data based on its appropriateness, in light of the materiality of exposures to be modeled.
* Sufficiency of the data to enable segmenting into sub-portfolios that exhibit variations in performance, and to evaluate potential options for such segmentation. For example, the length of a time-series is of particular importance for stress testing models, which aim to develop a linkage between model forecasts and economic drivers.
* For vendor models, a vendor may not be able to provide full transparency to evidence that this standard is met due to proprietary limitations. However, in cases where assessment of data appropriateness and sufficiency is limited by proprietary limitations, data sufficiency should be documented as a model weakness and steps should be taken to ensure that the model performs as intended. As an example, back-testing on internal data may serve to mitigate weaknesses in data sufficiency. Other standard model testing procedures such as sensitivity analysis or stress testing may also serve as mitigations when available.
  + 1. ***Source of data (internal KeyCorp data and/or external data), with justification on data source, especially for external data or qualitative judgment-based data used for KeyCorp attributes***

This section should document data sources, internal and/or external data, used to build the model. Any assessment on adequacy of data used in the model needs to be documented.

Where significant internal data deficiencies are found (e.g., short time series or presence of idiosyncratic events in the internal data) or if the nature of internal data makes it inappropriate for model development, alternative data sources are considered and justified, including external data and qualitatively-derived data. Document reasons why external data may provide a better fit for a model’s purpose (e.g., external economic and/or financial market data used as independent variables in a model), and document a link between the internal business and the external data utilized.

If qualitatively-derived data are considered for use, such data are based on judgment that comes from a source that has expertise in the subject. The rationale for use of expert judgment needs to be documented and explained in as much detail as possible to fully justify this choice.

For vendor models that are built on external data, the documentation requirements are the same as those for the internal data source. If a vendor may not be able to provide full transparency of data due to proprietary limitations, explain why internal data could not be used and why using external data is preferable. Please document why external data is representative of the Bank's situation. Summary information or measures on the data used (for example, summary statistics and frequency counts of development data and internal data) should be reviewed and compared in the event the vendor is not able to share the development data due to proprietary limitations. When additional assessments are performed, such as back-testing, sensitivity analysis, or stress testing, on internal data which provides an indication as to whether the development data used for a given vendor model was representative, document the testing results in this section, or reference to the appropriate sections in this document.

* + 1. ***Data appropriateness. Data are sourced from official central KeyCorp data stores, where such data are available and suitable for purpose. For data not sourced from official central KeyCorp data stores, controls associated with data and testing strategy***

This section should document data appropriateness for data obtained from various sources, such as an official central KeyCorp data store, alternative datasets used for model development, and vendor data (if applicable).

Where data from official central data stores are not suitable to meet development needs and alternative datasets are used for model development, provide a rationale for why the alternative dataset was an appropriate choice and describe controls that are in place to ensure the integrity and usability of the alternative data set.

If vendor data cannot be fully assessed for appropriateness due to proprietary limitations, this section should document this as a limitation.

* + 1. ***Review of data for quality, including completeness, representativeness, accuracy, and an assessment of any data weaknesses or limitations***

This section should document the assessment of development data (internal and external) for completeness, representativeness, and accuracy, which may include comparisons of data against existing reports and/or financial statements, validation of calculations within datasets, analysis of means and outliers, missing values analysis, and discussion of data quality and attributes with the business or data owners.

Any data limitations identified through the review of internal or external data and the data remediation techniques used, controls implemented, and conclusions, as appropriate, need to be documented.

* + 1. ***Data cleaning procedures are well-supported, transparent, and applied systematically, including treatment of missing values, outliers, data filtering, exclusions, and exceptions***

This section should document data cleaning rational and processes employed or other data remediation techniques to address known data weaknesses. This section should demonstrate that the techniques are applied in a transparent and systematic way. Sources of data weaknesses include, but are not limited to: incorrect data, missing data entries, unreliable or unverified data sources, and inconsistent data collection or cleaning methodologies.

If systematic data cleaning is performed, the following considerations should be followed and documented:

* Missing and incomplete data are handled systematically. If the amount of missing data are significant, the Model Developer documents that a robust approach was taken to compensate for shortcomings
* Applied cleaning processes are justified and based on sound industry practices (e.g., interpolation for mixing data entries), and are consistently applied within the dataset
* “Overrides” to raw data are identified and fully documented with justification
* Data exclusions to raw data, at times used to target populations of interest (e.g., exclusion of customers or accounts, or removal of outliers, etc.), are identified and fully documented with justification
* The use of pre-processed data such as ratios, averages, indices, or spreads is properly documented, with well-specified definitions, the specific calculation formula if applicable, and the identification of the underlying source data

If vendor data cannot be fully assessed for appropriateness due to proprietary limitations, this section should document this as a limitation.

* + 1. ***Data sampling techniques are conceptually sound, transparent, and applied systematically***

This section should document the use of sampling methods in constructing the development dataset. For example, the approach could be using accepted statistical techniques, with the sample size being adequate given the modeling approach, number of characteristics to be evaluated, and the size of the population. If there are concerns with the applicability or appropriateness of data sampling for a particular application, conservative approaches may be utilized and documented, and the full data population is used for modeling purposes.

If vendor data cannot be fully assessed for appropriateness due to proprietary limitations, this section should document this as a limitation.

* + 1. ***Data collection / processing steps are recorded to allow for replicability of data into final development set, including variable creation rules, transformations, and replication guides***

This section should document all steps in the data collection and processing, from raw data extraction, to data review analytics, to data cleaning, to sample selection in a logical, easy to understand manner. The impact of each step (e.g., number of data entries affected, changes to the range or mean of the data series) should be fully documented.

If vendor data cannot be fully assessed for appropriateness due to proprietary limitations, this section should document this as a limitation.

* + 1. ***Data and information adjustments and potential limitations***

If applicable, this section should document any adjustments (e.g. data transformations such as lags of variables, Weighted of Evidence (WOE), log transformation, etc) made to the model development data.

* + 1. ***Any additional applicable information***

This section should document any data information not covered by the above sections.

1. **Conceptual Soundness**

This section documents the general areas of model risk related to the model development methodology and approach.

1. 1. **Model Design and Segmentation**

This section is designed to document the assessment of the modeling approach / theory and review of the model developers’ and businesses’ support for the key modeling assumptions. Please respond to each of the subsections below with a comprehensive summary of the testing performed, results, and conclusions. If a particular subsection does not apply, please explain why it is not applicable.

1. ***Comprehensive review of model approach compared to alternatives, including academic and industry practices***

This section should document research conducted to identify alternative modeling approaches through a comprehensive review of published research and sound industry practices. The field of approaches may include any number of internal solutions or comparison of third-party vendor solutions. The assessments of the merits of potential approaches to the intended business uses and practicality of each of the approaches need to be documented. The assessments may include but are not limited to: data availability and obtainability, complexity, and development resource requirements. Document the final choice of modeling approach with appropriate support based on the research performed.

* + 1. ***Process for specification of model functional form with economic, business, and industry insight***

Note “Functional form” refers to a broad range of model specification decisions a Model Developer must make. For example, in the case of regression-based models of default probability, functional form covers decisions such as utilizing probit versus logit techniques.

This section should document functional form selection process, including but not limited to, alternative functional forms, testing and comparisons among candidates to determine the most appropriate functional form amongst the potential functional forms, and business insight and economic theory used to support the chosen functional form.

In the case of vendor models, document the evaluation process of different vendors and the rationale/appropriateness of the selection of an external vendor / third-party model based on economic and business insight. For existing vendor models, document whether the model continues to meet industry best practices.

* + 1. ***Assessment of key modeling assumptions and limitations of the model methodology and model inputs***

This section should document the assumptions and limitations embedded in each step of the model’s conceptualization process, specifically:

* Limitations of the selected modeling approach, such as overall robustness and theoretical reasonableness
* Major underlying assumptions of the selected modeling approach, including functional form, model inputs, parameter estimation, and qualitative inputs
* Assumptions and limitations of vendor models

Assumptions are supported by quantitative analysis, which may include:

* Direct support for the assumption based on quantitative measures (e.g., graphical analysis, benchmarks or other proxies, analysis of model errors)
* Sensitivity analysis, to indicate the degree of impact of the assumptions and highlight assumptions for which further analysis may be warranted

If full transparency of the model assumptions or limitations are unable to be obtained due to proprietary limitations, this section should document the limitations. Alternative model testing procedures leveraged to assess model assumptions and limitations, such as scenario analysis, sensitivity analysis or stress testing, need to be documented.

For each weakness / limitation identified, document a description of the associated model risk and, if applicable, the risk mitigant(s) designed to address this risk. Risk mitigants can include, for example, limits on the model use, adjustments to model outputs, and additional governance and review of model results.

* + 1. ***Comprehensive assessment of the suitability of the development data for formulating the proposed modeling approach***

This section should document comprehensive evaluation on the adequacy of the development data for formulating the model. The evaluation may draw, in part, on simple summary statistics that contain the distribution of each variable in the development dataset, including total observation counts, missing values, min, max, mean, median, standard deviation, and selected quantiles.

If full transparency of the suitability of the development data for formulating the proposed modeling approach are unable to be provided due to proprietary limitations, this section should document this as a limitation.

* + 1. ***Complexity of model and appropriateness based on requirements of model use***

This section should document the complexity of model and appropriateness based on requirements of model use. This section also documents model materiality (e.g., in terms of portfolio size, or expected loss) which normally informs complexity – with less complex models generally being preferred over more complex models for models of lower materiality.

In the case of vendor models, document whether the selection of an external vendor / third-party model is most appropriate based on the merits of the model regarding data availability, transparency and complexity. Where new vendor models are replacing or augmenting existing models, document the comparison of the new vendor model against incumbent models or existing decision rules to ensure any added complexity of the vendor model is compensated by improvements in model performance, control, or transparency.

* + 1. ***Feeder model output being used as the model input is defined, fully understood, and justified***

This section should document the evaluation of the appropriateness of using outputs from other feeder models, including whether the feeder model has been approved for use by Model Risk for the specific purpose, such as the independent model validation rating of the model and the reasoning of the rating, and the implications of “error in variables” of findings in the current model application.

Also, ensure the Model Developer of this model is identified as a primary stakeholder of the downstream model, as applicable.

* + 1. ***Model segmentation approach, supported by economic and business insight***

This section should document the appropriateness and reasons of model segmentation approach, including but are not limited to, a set of segmented models may outperform a single model if the relationship between the input variables and the output variable varies by segment, the need to segment is driven by different input variables affecting the sub-populations, or the same input variables affecting subpopulations differently, and additional granularity in segmentation is appropriate when it results in a meaningful improvement in model performance in order for it to sufficiently compensate for the additional complexity.

Document any supporting analysis for the segmentation, e.g., statistical tests of fitted time series for the same set of model specifications, histograms demonstrating the similarity of portfolio behavior, etc.

Document any consideration on materiality of segments, market practices, any homogeneity, and data limitations.

If full transparency of the segmentation approach is unable to be provided due to proprietary limitations, this section should document the limitations and additional assessments, such as performance testing, conducted by the model developer on the appropriateness of vendor segmentation.

* + 1. ***Any additional applicable information***

This section should document any model information not covered by the above sections.

* 1. **Parameterization**

This subsection documents the statistical, economical, and business techniques used to derive parameters. It explains the appropriateness and robustness of the selection of parameters. Please respond to each of the subsections below with a comprehensive summary of the testing performed, results, and conclusions. If a particular subsection does not apply, please explain why it is not applicable.

1. ***Variables are theoretically sound and supported by business and economic insight***

This section should identify the justification of the candidate variables that can be used within the model. The variables should be rationalized with subject matter experts to ensure that they are economic and behavioral drivers of the model output, supported by available research.

For vendor models, the types or categories of candidate model variables considered should be identified and documented. This should be available from the vendor. If not, document this as a limitation.

1. ***Document variable transformation processes to ensure the transformations are systematic and transparent***

This section should document any necessary transformations of the variables for modeling, as well as the rationale for data transformations. Transformations should be based on established modeling practices and consider both business rationale and statistical tests; all of which should be reflected in the documentation. Also included should be a variety of transformations of the variables (e.g. lagging/leading variables, quarterly change, annual change, etc.).

Often, for vendor models, this information will be proprietary. Through testing and review of the vendor materials, a better understanding of the process may be obtained and should be documented. If vendor proprietary information is unobtainable, document this as a limitation.

1. ***Document the process for selection of final variables including statistical, economic, and business support***

This section should document the selection of final variables used in the model. Support for the selection of these variables should be from a statistical, economical, and business perspective. All potential variables should be considered, with justification for the final selection.

For vendor models where provision of the final variables may be unavailable, efforts should be made to obtain and review the type and nature of variables of critical use and review with the subject matter expert for reasonableness. If vendor proprietary information is unobtainable, document this as a limitation.

1. ***Process for selection of parameter estimation including statistical, economic, and business support***

This section should document the parameter estimations of the variables identified in section 3.2.3. Appropriate tools and theoretically sound formulas and methodology should be used and documented accordingly. Each step of the parameter estimation process should be explained and included within the documentation. The parameter estimations should also be supported from both economic and business perspectives.

For vendor models where this information is unavailable due to proprietary limitations, additional tests and analysis should be performed or the described techniques within the vendor’s documentation should be reviewed to better understand the process. This should be documented.

1. ***Any additional applicable information***

This section should include any other applicable information that may relate to the parameterization of the model.

1. **Testing and Final Model Selection**

This section confirms that the model is functioning and performing appropriately, including evaluation by the Model Owner and Model Users.

1. 1. **Testing**

This section documents the testing / outcomes analysis of the model. The objective of this section is to provide assessments and testing results to confirm that the model delivers accurate and robust results for the required model uses. Please respond to each of the subsections below with a comprehensive summary of the testing performed, results, and conclusions pertaining to the components of the outcomes analysis. If a particular subsection does not apply, please explain why it is not applicable.

1. ***Identify tests that collectively ensure the model is functioning as designed, including but not limited to backtesting (in-sample model fit, and out-of-sample/out-of-time model fit), model robustness/stability, benchmarking analyses, sensitivity analyses, stress testing, and any process maps and scripts used in the testing process, as applicable***

This section should document relevant model testing that will assess the appropriateness and robustness of the model. The nature of testing will depend on the type of model. As different tests have strengths and weaknesses under different conditions, a variety of tests should be identified. Document the purpose, design, and execution of the test plan, with sufficient commentary on summary results and detailed analysis of informative samples. The testing process should demonstrate and document with support at a minimum:

* The model’s accuracy, ensuring that the model is robust and stable
* Any potential model limitations and boundary conditions
* An evaluation of model’s behavior over a range of input values
* An assessment of the impact of assumptions and identification of situations where the model perform poorly or becomes unreliable
* The applicable of testing to actual circumstances in a variety of market conditions, including extreme conditions
* An evaluation of the impact of model results on other models / downstream models that rely on results as an input.

Documentation should also include outcomes analysis and other testing, which depends on the objectives of the model and may include an assessment of the accuracy of estimates or forecasts, an evaluation of rank-ordering ability, or other appropriate tests. Model performance should be evaluated by establishment of expected ranges for actual outcomes compared to intended objectives, with explanation for any observed variation between the two. Document the appropriateness of each of the selected tests. Where possible, testing may include, but is not limited to:

* Backtesting (both in-sample and out-of-sample/out-of-time/data not used in development) to demonstrate actual outcomes with model forecasts during a historical time period or predictive power of a model by changing the original development sample,
* Sensitivity testing to determine the impact of changes in inputs, data partitions, assumptions, parameter values, and market conditions on model outputs. Results should be documented and interpreted for reasonability.
* Scenario analysis to test the model across a variety of scenarios with consideration to the intended horizon of the model. Possible future developments or events should be considered in order to review the model’s reaction to said events. Results, with emphasis on any concerns, should be documented.
* Benchmarking to compare the model results against a comparable model (e.g. challenger models or third-party models). Discrepancies between the model output and benchmark should be investigated and documented.

For Vendor models where full details may be unavailable, Model Developers should place emphasis on and document accordingly the evaluation of any provided testing results when full details are unavailable.

1. ***Establish preliminary expectation of the testing output***

This section should document preliminary expectations and acceptance thresholds of the model testing and be completed prior to the execution of the testing. These should be used as a hypothesis to the testing results by taking into account acceptable ranges from both a statistical and business standpoint. The expectations may incorporate Model Owner expectations, which should be documented.

For vendor models where full details may be unavailable, average or general summary of testing results from other clients employing the same model may be used to determine expectations for model testing output. If vendor proprietary information limits the ability to establish expectations, document this as a limitation.

1. ***Execution of the required tests and assessment of results***

This section should document the testing results associated with the tests identified in 4.1.1. These should be compared to the expectations identified in 4.1.2. Any major discrepancies should be explored and documented, including:

* Identification of any discrepancies between expectations and actual test results
* Qualitative and quantitative assessment of these discrepancies, including any further investigation conducted
* Justification of the reasonableness of the outcome or identification of unacceptable outcomes

Testing of alternative approaches that were ultimately not selected due to poor test performance or other reasons should also be documented. Such test results and conclusions often form an important component of the justification for the final approach or assumption selected.

For vendor models where full details may be unavailable, emphasis on evaluating provided test results and applying a robust ongoing monitoring process should be considered. If vendor proprietary information limits the ability to determine the accuracy and soundness of the model, document this as a limitation and include sufficient statistical, business, and economical support that justifies the use of the model.

1. ***Establish any boundaries of model effectiveness and assess validity of the model***

This section should document any conditions which the model assumptions and/or structure is no longer applicable, resulting in significant expected model deterioration. Factors to consider include a certain range of input values, market conditions, or other factors. The documentation should identify the source of divergence from expectations and confirm the validity of the model if results deviate significantly. All boundaries should be monitored.

Vendor models may not provide such information. In this event, ongoing monitoring should identify tests and thresholds to assess ongoing appropriateness of the model.

1. ***Provide Model Forecasts / Results and assess for reasonability***

This section should document ongoing expectations of the model’s forecast/results that can be used to assess the ongoing appropriateness of the model results. This should include both qualitative and quantitative rationale, and may include ranges. This can be used later to assess the appropriateness of the model’s results.

1. ***CCAR Testing (as applicable)***

This section is for CCAR models and should incorporate various scenario testing results as well as other factors to ensure that the model is appropriate for CCAR or stress testing purposes. Ensure that a range of macroeconomic factors were included and that the macroeconomic factors chosen for modeling are both quantitatively and qualitatively appropriate.

1. ***Effectiveness of the processing components - The code and processing calculations and results should be independently replicated to match the previous sections of the documentation. For example, a model implemented in a SAS projects, must have the SAS code run, results match, and any supporting data/documentation needed included. Ideally, this is one stage of the peer review***

This section should provide evidence that the code and processing calculations have been independently replicated and the implemented model is in accord with the documented model. This should include proofreading the code, running scenarios with known outcomes, and replicating the code.

Vendor models may not provide such information. In this event, document this as a limitation. Also, ensure ongoing monitoring identifies tests and thresholds to assess ongoing appropriateness of the model.

1. ***Any additional applicable information***

This section should include any other applicable testing information that may be relevant to this particular model.

* 1. **Final Model Selection**

This section documents the vetting of the final modeling approach and its appropriateness with all primary model stakeholders. Please respond to each of the subsections below with a comprehensive summary of the activity performed. If a particular subsection does not apply, please explain why it is not applicable.

1. ***The final model is selected with input from the Model Owner and all known Model Users and meets intended business uses/scope and regulatory requirements***

The section should document any communication activity among the model developer, model owner, and model users on the selection of the final model selection, including advantages and challenges of the modeling approach and any alternative models considered. Additionally, include within this section any review of the applicability, accuracy, and intuitiveness of the model estimates (parameters, output). Confirm that the business uses/scope of the model meet intended business uses and regulatory requirements, as identified in section 1.1.3 and 1.1.4.

1. ***Document management overlays to raw model output to remediate model limitations, and ensure they are justified and done transparently and systematically, with appropriate review and approval***

This section should identify any situation where overlays are required and provide justification for any overlays to raw model output. Overlays should be implemented in a transparent manner and in such a way that the output can be evaluated with and without the overlay. The process for applying overlays should be included here with support from model developers, model owners, and model users, and be systematically applied to ensure that the model users receive the agreed-upon fully adjusted model output. Additionally, if review and approval of overlays are necessary, this process should be documented (i.e. identify the committee or individual reasonable for approving overlays).

1. ***Any additional applicable information***

This section should include any other applicable information that may relate to the final selection of the model.

1. **Handoff and Ongoing Monitoring Plan**

The objective of this section is to ensure the transfer of the developed model into a production environment is sufficiently robust and the required ongoing monitoring activities are defined and sufficiently understood from both a qualitative and quantitative perspective.

1. 1. **Model Handoff**

The objective of this section is to ensure the transition of the developed model into a production environment is sufficiently robust. The model developers should consider the computational burdens and feasibility of implementation into a production environment. To confirm a sound transfer of the model from development into production, please respond to each of the subsections below with a comprehensive summary of the activities performed. If a particular subsection does not apply, please explain why it is not applicable.

***The final model choice, including data requirements, parameter estimation, and documentation, is developed in such a way to facilitate model handoff, including:***

1. ***Raw datasets and a data dictionary describing the data attributes***

This section should ensure that the model owner obtains the raw datasets (e.g. data directly from source system without being processed) used for model development. Also, the model owner should obtain a data dictionary describing the attributes included within the data. As these may be large files, it may be optimal to save this information on a shared drive or other source with secured access and cite the location here. Retention of this information is important to ensure that there is sufficient transparency, corporate memory, insight, and to ensure that the modeling process can be validated independently, as necessary.

For vendor models, this may be unavailable, and the documentation should reflect the evidence from the Appropriateness and Integrity of Data section 2.

1. ***Documented code used to aggregate raw dataset from source systems and transformation of the raw dataset into final development datasets***

This section should ensure that the model owner obtains any code used to transform the source data into a final development data set. Please provide final details such as locations where the data aggregation code to transform to final data sets and the code walk through are saved. Code walk through refers to details related to how to run the code. Save all relevant information on a shared drive, SASGrid, or other sources with secured access and cite the location here. Retention of this information is important to ensure that there is sufficient transparency, corporate memory, insight, and to ensure that the modeling process can be validated independently, as necessary.

For vendor models, this may be unavailable, and the documentation should reflect the evidence from the Appropriateness and Integrity of Data section 2.

1. ***Final model development sets (or evidence to support data standards for vendor models)***

This section should ensure that the model owner obtains the final development data set used to create the model. Please document the final dataset location details and save this information on a shared drive or other source with secured access and cite the location here. Retention of this information is important to ensure that there is sufficient transparency, corporate memory, insight, and to ensure that the modeling process can be validated independently, as necessary.

For vendor models, this may be unavailable, and the documentation should reflect the evidence from the Appropriateness and Integrity of Data Section 2.

1. ***Information about the production implementation platform, including upstream and downstream dependencies.***

This section should identify the platform where the model resides (e.g. Excel, SAS, Linux, QRM, a vendor). Additionally, all upstream dependencies (e.g. models, tools, applications that are required to operate the model) and downstream dependencies (e.g. models or reports that need the output of this model) should be identified. Include the appropriateness of such sources for upstream dependencies. For downstream dependencies, document a process to ensure that the model’s output continues to provide the necessary support for the downstream use.

1. ***Once model is implemented, include evidence that the implementation is consistent with the documented model***

This section should document the implementation testing results confirming that the model as developed performs identically to the model in production. This testing should be comprehensive and test a variety of scenarios. The conclusion should be that the model as implemented performs consistently with the documented model.

1. ***Any additional applicable information***

This section should include any other applicable information that may relate to the handoff of information related to the model.

* 1. **Ongoing Monitoring Plan**

This section is designed to document the ongoing testing and metrics to be used to assess the ongoing performance of the model. Ongoing monitoring holistically assesses the performance and appropriateness of the model. For vendor models, this plan should provide the general testing results provided by the vendor as well as the performance on Key’s data to ensure appropriateness for Key. Please respond to each of the subsections below. If a particular subsection does not apply, please explain why it is not applicable.

1. ***Document the types of tests (i.e. Back-testing, Sensitivity Analysis, Override Analysis, and/or Benchmarking) that will be performed regularly to ensure model performance is completely assessed***

This section should include and justify the testing that should be performed for monitoring ongoing model performance. Back-testing, sensitivity analysis, analysis of overrides, and benchmarking are some commonly used tests. Depending on the type of model, there may be additional key performance metrics to ensure model performance is completely assessed. Additionally, consider the tests performed in section 4.1.3. Include justification to support that the testing identified will ensure model performance is completely assessed.

1. ***Identify Thresholds / Triggers for tests with statistical and business rationale***

This section should document thresholds or triggers that would require additional action to ensure that the model is continuing to provide the business with output that is appropriate to make business decisions. As such, these thresholds or triggers should be supported from both a statistical standpoint as well as from the line of business that uses the output. Thresholds should exist for each test performed in section 5.2.1 or rationale should be provided for why a threshold is not necessary.

1. ***Reassessment of model limitations identified in development state***

This section should include an ongoing assessment of the model limitations that were identified in development and the appropriateness of these limitations in the current modeling environment. This assessment should identify the impact of limitations in production and the ongoing appropriateness of the limitations. If any limitation could be mitigated in the future, identify how this could occur (e.g. if internal data was a limitation, how much data is needed until there is a sufficient amount of internal data? Would this prompt a redevelopment? Why or why not?).

1. ***Reverification of internal and external data inputs***

This section should state the internal and external data inputs and the ongoing appropriateness of these sources. Consider if the current population remains aligned with the development data set (e.g. has there been a policy change or regime change that would impact the effectiveness of the data?). For external data, justify that this source continues to be appropriate for KeyBank and that additional internal data that may be more suitable has not become available.

1. ***Evaluate whether changes in data, products, exposures, activities, clients, or market conditions necessitate an adjustment, redevelopment, or replacement of model***

This section should identify the factors that may change over time and impact the model, including but not limited to data, products being modeled, business exposures, activity in the space, a change in clients, or a change in market conditions. Additionally, a current assessment of these conditions should be provided, highlighting any major change and any necessary action (e.g. adjustment, redevelopment, replacement) that may be required in response to the change in the modeling environment.

1. ***Document escalation procedures in the event of a threshold / trigger breach***

This section should include actions that are taken in the event of a threshold or trigger breach, as identified in step 5.2.2. These procedures should be as specific as possible, identifying the level of management that breaches will be escalated to and required actions (e.g. sign-off by senior management, redevelopment, manual review, etc.). The required action for threshold breaches may vary based on the specific test.

1. ***Identify the required frequency of monitoring***

This section should include the frequency of monitoring activity. Note that Model Risk requires at least an annual evaluation of the ongoing appropriateness of each model. Depending on the nature of the model (risk, frequency of use, number of thresholds, past performance, number of findings, etc.), the frequency of monitoring may increase.

1. ***Any additional applicable information***

This section should include any other applicable information that may relate to the ongoing monitoring of the model. For vendor models, the ongoing monitoring requirements are the same as the internally developed models. Additionally, ongoing communication with the vendor to share the model performance over time and address any model changes should be taken into consideration.

1. **Governance and Control Activity**

This section is to provide additional information on the governance and control structures in place to ensure the overall soundness of the model control environment including proper oversight of the model’s performance and the accuracy/integrity of the model output. Please respond to each of the subsections below. If a particular subsection does not apply, please explain why it is not applicable.

1. 1. **Governance and Control**

This section is designed to detail the appropriateness of the operation of the model by identifying the design and execution of governance and control activity as noted in the steps below. This should note any complexities or subtleties within the model that warrant additional consideration. Based on the model’s purpose, use, simplicity, etc., the magnitude of detail for this section may vary, but should identify compensating activity or controls when certain controls are deemed unnecessary.

1. ***Model Security to ensure that only authorized individuals can access the model, including frequency of review***

This section should include sufficient detail to attest to the security of the model to ensure that the model and its results are secure from unauthorized personnel or mistaken/erroneous input. It may be advantageous to include the location of the model, its results, and other important documentation (e.g. model documentation, operating procedures, etc.). Model Security may be assessed through a regular review of individuals with access to the model, password protection with a procedure to continually update the password on defined intervals, having read-only access for a model in production, or other ways.

1. ***Change Management to provide sufficient corporate memory, business interpretation, and to ensure unapproved changes do not occur***

This section should document the details of the change management processes related to the model. For example, how changes are made to the model, how they are tracked and monitored, and how to prevent inadvertently or intentionally changing the model or modeling process. Additionally, change management should provide sufficient corporate memory to understand the progression of the model and to assist in business interpretation of the modeling results. A common change management process is a change log, which tracks changes and includes information such as change details, impact assessment, individuals making the change with date, individual testing the change with testing results, approval of the change with date, and date of implementation.

1. ***Model Version control to ensure that the approved model is used in production***

This section should detail the actions taken to ensure that the model used in production is the approved model and that it is executed consistently and appropriately. This could be confirmed through a version control on the model and documentation (e.g. version 1.3) or a date of execution. If the model is automated, the code may ensure that the appropriate version of the model is used and could be included as evidence.

1. ***Model Governance/Oversight – detailing Committees or Working Groups that review the model and/or its results, including frequency of meetings***

This section should detail the oversight activity that ensures the model is used in an appropriate manner with realistic results. The model material/information/results should be presented to Committees, Working Groups responsible for oversight of the model, or Line of Business user meetings, as applicable, regularly and in an interpretable manner. Include with justification the frequency of this oversight, information that is to be escalated (e.g. performance monitoring, model changes, findings, etc.), and the members of this group.

1. ***Policies and Procedures that detail how to operate and/or maintain the model***

This section should document policies and/or procedures, as applicable, created to consistently and accurately operate and maintain the model. The level of documentation needed may vary based on several factors (e.g. complexity, frequency of operation).

1. ***Vendor Management including ongoing discussion with the vendor and a contingency plan in the event that the vendor becomes unavailable***

This section is only necessary for modeling processes that rely on vendors or third parties to execute or maintain the model. For models that rely on vendors, include information on the frequency and content of discussions with the vendor to ensure that the vendor products continue to be appropriate and functional for KeyBank purposes. Additionally, include the Contingency Plan for the model which formally details actions that will be taken by Management in the event that the vendor is unavailable for use. The plan should specifically cite alternative processes (e.g. the specific platform where the model could be moved internally or a specific vendor that could provide KeyBank with the services required). Consider time and costs associated with the transition strategy. In many cases there are short-term and long-term components to Contingency Plans, please document both as applicable.

1. ***Any additional applicable information***

This section is to include any other applicable information that may ensure the ongoing appropriateness of the model.

1. **References, Peer Review, and Documentation Visibility**
2. 1. **References**

Please include any applicable references below:

* 1. **Peer Review**

Prior to GRC Attestation, this Model Documentation form was subject to a peer review. Please provide the peer review information below.

Peer Review LOB: Please enter Peer Review LOB

Peer Reviewer: Please enter Peer Reviewer

Date: Please enter date of Peer Review

* 1. **Documentation Visibility**

Would you allow this template to be made visible to other model owners?

Please enter ‘yes’ or ‘no’.