



products and utilization, general business information and information about what type of account the business partner had, which are collected about all clients at a specific month.

To comply with the OSFI Guidelines on Model Risk Management¹ (September 2017) and ATB Model Risk Management Policy² and Framework³. The Model Risk Management Team (MRM) conducted independent validation on the model. The following exercises were conducted during the validation of the model:

- Evaluation of model development document;
- Reviewing and testing of modeling data and inputs;
- Assessing model conceptual soundness and assumptions;
- Testing and verifying model calculation;
- Testing and verifying model output;
- Assessment of the adequacy of the model development process and risk controls;
- Evaluating the model's performance monitoring plan and model governance.

During this validation, MRM has identified some issues with this model. MRM noticed that the model development team did not have UAT tests (parallel test and User Acceptance Test) for this model. MRM highly recommends that the modeling team should do the UAT test before putting the model in the production. Several model documentation issues have also been identified. Issues related to target variable design error and feature treatments have been closed after the modeling team fixed the errors before this report is finalized.

The conclusion of this vetting/initial validation is **Acceptable, but improvements required**. Therefore, the model is accepted for its intended use, but a UAT test is required before production.

¹Enterprise-Wide Model Risk Management for Deposit-Taking Institutions:
<http://www.osfi-bsif.gc.ca/Eng/fi-if/rg-ro/gdn-ort/gl-ld/Pages/e23.aspx>

²Model Risk Management Policy:
<http://community.insideatb.net/resources/policies/Documents/model-risk-management-policy.pdf>

³Model Risk Management Framework:
<http://community.insideatb.net/resources/policies/Documents/model-risk-management-framework.pdf>



Table 1a provides a summary of the observations identified by MRM during the validation of the model. Table 1b lists the model's limitations as identified by the model owner in model development documentation, along with any other limitations that MRM may have identified during the validation of the model. Table 1c lists the recommendations for future improvement from MRM identified during this model validation.

Table 1a Summary of the Observation severity, Observation Description, and Remediation Timeline

Observation #	Severity	Observation Description	Status	Remediation Date
3.8.2	Medium	Model Execution <ul style="list-style-type: none"> MRM noticed that the model development team did not have UAT tests (parallel test and User Acceptance Test) for this model. MRM recommends that the modeling team should do the UAT test before putting the model in the production. 	Open	



3.1	Low	<p>Model development Documentation</p> <ul style="list-style-type: none"> ● Lack of information regarding the model limitation ● In feature reduction technique pertaining to principal component analysis (PCA), the feature with the smallest 1-R_square ratio have to be used to present its group. In model development documentation , the model owner mentioned the highest 1-R_square ratio was selected. MRM notes that this rule was followed by Model Owner in <i>'NBC_Savings_model.ipynb'</i> code, but the model development documentation should be corrected. ● Per model development documentation, it seems that the model owner includes all new customers who already have a saving product at that time point of opening. Although MRM notes that the modeling data construction code(<i>'NBC_Savings_model_data_setup.ipynb'</i>) is correct and exclude all new customers who already have a saving product at that time point of opening in Target=1 group, MRM highly recommends that the model documentation should be corrected and aligned with the code to show this exclusion 	Open	
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		<ul style="list-style-type: none"> Per 'NBC_Savings_model_data_setup.ipynb', MRM notes that 'Deposit_business_account_balance' (converted to 'business_deposit_balance'). The model documentation has to be corrected. 		
3.3.3.2	Medium	Data Assessment <ul style="list-style-type: none"> MRM is the view that the 'has_atb_wealth_products' has to be an exclusion criteria at the data preparation step. Per discussion with the modeling team, MRM is addressed that 'has_atb_wealth_products' clients are not excluded from the saving offer model and the client-facing team are still encouraged to use the correct protocols when considering a client for this product. Therefore this observation is closed 	Closed	Jan 26, 2023
3.3.3.1	Medium	Data Assessment <ul style="list-style-type: none"> MRM notes that some variables like 'is_non_resident', and 'is_staff' were dropped by the model owner during the model development process. MRM is of the view that these variables have to be as exclusion criteria at the data preparation step, rather than drop them. Per discussion with the modeling team, MRM is addressed that 'is_non_resident' and 'is_staff' clients are not excluded from the 	Closed	Jan 26, 2023



		<p>saving offer model and the client-facing team are still encouraged to use the correct protocols when considering a client for this product. Therefore this observation is closed</p>		
3.3.4	High	<p>Modeling Data Replication</p> <ul style="list-style-type: none"> MRM independently runs the modeling data construction code for the data creation used as input for the model building process. MRM did not succeed in replicating the final data since the modeling data construction code(Jupyter notebook data exploration and modeling dataset creation) to create Target=0 is not correct. The code has to be corrected and aligned with the model development documentation 	Closed	Feb 17, 2023
3.6.3.b	High	<p>Model Building Code</p> <ul style="list-style-type: none"> MRM reviewed the code presented by the model owner and notes that although all the nonbinary variables have been normalized using the scikit-learn Normalizer module, the normalized values are not used in the model development process. Therefore MRM was not able to replicate the results including the model performance metrics. The code has to be corrected and aligned with the model development documentation. 	Closed	Feb 17, 2023



3.6.3a	High	<p>Model Building Code</p> <ul style="list-style-type: none"> MRM reviewed the code presented by the model owner and notes that the code to create Target=0 is not correct. There are some clients (1433) in the training dataset and (752) in the test dataset who had a saving product in the previous month (preceding_flag), but were not dropped. Per model documentation in modeling design, all customers with saving products in the previous month in both groups of 'Target'=0 and 'Target'=1' should be excluded. The code have to be corrected and aligned with the model development documentation 	Closed	Feb 17, 2023
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Table 1b A List of model Weakness/limitation and Recommendations for Future

Model Limitation	Risk	Recommendation
The model is built on the historical data of 3 years and the model owner has assumed that a client who will uptake a short term saving product has a similar behavior or demographic profile to a client who already has opened a savings account in the recent past. The model development team also assumes that this holds true into the future.	There might be a potential decay in accuracy when it will be used to predict a new production data.	The model development team should adopt a regular model performance review and regular training of the model to mitigate this decay
Potential changes in data sources in Deep	It could affect the reproducibility of original modeling dataset so all aspect of the model could be affected	



Table 1c - Recommendations for improvements to the New NBC Saving Offer Model

S.No.	Recommendation/ Suggestion for improvement to the model
1	MRM notes that Monotone constraints were not imposed on predictors during the model building process. As setting monotonic constraints can reduce overfitting and improve the model performance, MRM suggests that the model owner impose these constraints on predictors during model fitting
2	MRM notes that the model 'Explainability' as part of the model ethics are not established where the model developer has not conducted comprehensive model explainability tests such as 'Local interpretable model-agnostic explanation (LIME) and/or Leave-One-Covariate-Out (LOCO) as the industry common practice to understand how the model makes decisions for a single instance and explain the individual predictions.
3	MRM suggests that the model owner conduct the model 'Stability' test such as population stability index (PSI) indicating the population shift in the data period when this model was developed.
4	MRM recommends the modeling team to have a detailed model monitoring plan on model performance, to capture significant early warning signals in model performance deterioration and population shifts.
5	MRM highly recommends that the model owner ensures if all features in the final model make business sense.
6	MRM notes that the model owner dropped some features with dominant values (>99% Zeros) during the model development process. MRM highly recommends that the model owner ensures if these features are not informative features in the model building process.

2.0 Model Information

The Next Best Conversation (NBC) Saving Offer model has been developed to make predictions about whether an ATB retail customer will open a short term Savings