Model Monitoring and Statistical Change Analysis by Year

This report summarizes the year-by-year review of model diagnostics using population stability index (PSI), parameter drift, excess predictive value, and predictive performance metrics (R², MAE, lift charts). For each year where material changes were observed, we analyze population shifts, modeling implications, and whether adjustments are recommended.

# Year: 2005

* Notable Statistical Findings:
* - Significant PSI changes in avg\_income\_cat and fico\_missing.
* - Drop in R² and increase in MAE suggests a mild decrease in model accuracy.
* - Parameter drift and excess predictive value changes in fico and avg\_income.

## 1. Population Changes Observed

Yes. PSI and distribution shifts indicate changes in customer segments. These may reflect changes in marketing, economic climate (e.g., recession or pandemic), or data collection processes that altered the profile of customers entering the system.

## 2. Model Changes Suggested

Yes. The diagnostics support updating the model.

1. a. Change in Functional Form or Specification?

Possibly. Particularly in years with significant parameter drift or shifts in predictive value, a new functional form (e.g., nonlinear or interaction terms) may be more appropriate.

1. b. Remove Some Variables?

Yes, in certain years variables like income or fico\_missing became unstable or less informative.

1. c. Add Some Variables?

Yes. Variables capturing economic stress, policy shifts, or customer intent might help during volatile years like 2008 and 2020.

1. d. Re-estimate the Same Model?

Yes. In many cases, re-estimating the model with updated parameter values and recent data would help restore accuracy without major structural changes.

## 3. Notification-Only Years

In some years (e.g., 2010 or 2022), the changes are noticeable but do not warrant immediate intervention. Stakeholders should be informed that the model is performing within acceptable parameters, but should be monitored closely if trends continue.

# Year: 2008

* Notable Statistical Findings:
* - Extreme PSI spikes in fico\_cat and fico\_missing (likely reflecting recession impact).
* - Lift chart shows downward deviation in lower bins; MAE rises.
* - Parameter estimate for fico shows instability; recommend model review.

## 1. Population Changes Observed

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## 2. Model Changes Suggested

Yes. The diagnostics support updating the model.

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# Year: 2010

* Notable Statistical Findings:
* - Significant drift in density\_cat PSI; excess predictive value shifts in fico\_missing and num\_bankruptcy.
* - Model performance remains stable, but parameter fluctuations suggest customer behavior change.

## 1. Population Changes Observed

Yes. PSI and distribution shifts indicate changes in customer segments. These may reflect changes in marketing, economic climate (e.g., recession or pandemic), or data collection processes that altered the profile of customers entering the system.

## 2. Model Changes Suggested

Yes. The diagnostics support updating the model.

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# Year: 2014-2016

* Notable Statistical Findings:
* - Drop in R² and increased MAE indicate model degradation.
* - Significant parameter drift in intercept, fico, credit\_limit.
* - Excess predictive value for density and credit\_limit suggests changing model relevance.

## 1. Population Changes Observed

Yes. PSI and distribution shifts indicate changes in customer segments. These may reflect changes in marketing, economic climate (e.g., recession or pandemic), or data collection processes that altered the profile of customers entering the system.

## 2. Model Changes Suggested

Yes. The diagnostics support updating the model.

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# Year: 2020-2021

* Notable Statistical Findings:
* - Sharp model degradation in R² and MAE; lift chart shows declining separation.
* - Extreme PSI and excess predictive value in fico\_cat and fico\_missing.
* - Parameter estimates for num\_late, fico, and bankruptcy show instability; pandemic likely influenced shifts.

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## 2. Model Changes Suggested

Yes. The diagnostics support updating the model.

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# Year: 2022

* Notable Statistical Findings:
* - Some stabilization in MAE and minor recovery in R².
* - High PSI in avg\_income\_cat and density\_cat; excess predictive value still significant.
* - Model may still benefit from recalibration.

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Yes. PSI and distribution shifts indicate changes in customer segments. These may reflect changes in marketing, economic climate (e.g., recession or pandemic), or data collection processes that altered the profile of customers entering the system.

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Yes. The diagnostics support updating the model.

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