TAZI

White Paper

Non Performing Loan Prediction with Continuous, Explainable AutoML

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SUMMARY

Identifying Non Performing Loans (NPL) is a dynamic and ongoing problem that financial institutions face. The classification for a particular loan application should be done instantly before giving the decision of lending a loan. If NPLs are not recognized properly by the financial institutions, major problems are prone to arise such as bank insolvency or zombification.

Regulators and supervisors should ensure that loans are given to deserving applicants so that the borrower is able to repay the loan to the financial institution.

The output of NPL models is used by Risk Management teams to make analyses out of the model. Eventually, the model output helps the lender give a lending decision based on the historical data within the financial institution. This paper explains the approach of the TAZI Non-Performing Loan Solution.

The solution is based on TAZI's patented Continuous and Explainable, No-Code, Automated Machine Learning platform. How continuous learning explores the default patterns will be discussed. Moreover, how the business units will approach rating the risk of the potential loans is to be explained. Conclusively, the customization level of this solution will be explained and potential savings for the financial company will be discussed.

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INTRODUCTION

An NPL is a state for a particular loan where the applicant is not able to fully repay the loan 90 days after the last payment date. After this period, the loan is considered an NPL and the loan application is labeled as "default". If it is fully paid before the period, it is labeled as "successful".

The data for loan applications can be gathered from the loan application information within the institution. If available, the applicant's information can be also gathered from other financial institutions. Gathering information from other institutions may also help the lender to decide on a powerful target variable - which states whether an application is successful or defaulted.

For a new application, there are many features of the applicant to be examined for the decision of lending a loan or not. A platform that examines previous data patterns and suggests defaulting loans beforehand would be beneficial to assess the true risk management measures.

Many companies nowadays have large data science teams. Building analytical models, as well as maintaining them may consume large amounts of time. The traditional Machine Learning pipelines are able to detect complex patterns with high accuracy. However, these pipelines are very complex, hard to maintain, and not interpretable. TAZI's Continuous AutoML platform is designed to be understood by business experts from all backgrounds, regardless of data science experience. The platform is continuously synchronized with the business changes thanks to its continuous learning technology. This allows business users to receive continuous feedback on the models they build, and consequently take actions from the interpretable ML.

TAZI's Non-Performing Loan Solution predicts the potential defaulting loan applicants by looking at the information available at the time of application. The lender can then see the profits gained or risks exposed by the decisions given on the particular application. In the long run, a continuous learning model can significantly reduce costs.

NON-PERFORMING LOANS IN FINANCIAL INSTITUTIONS

The financial institution can increase profits by capturing default credits beforehand. In general, segments are decided by the executives within the organization (like Risk Management). The models can be built individually for each segment or all segments combined. Customer segmentation can increase the performance of the model since the important features for each segment can vary as well as the payment trends.

Loan risk varies over time and depends on many other factors such as Recoveries, Employment Length, Job Title, Loan Amount, Home Ownership, etc. Traditional ML strategies are generally not reimplemented unless they fail. Therefore, recognition of the changing patterns over time is not possible, especially in environments like changing inflation and payment trends. Rebuilding new models frequently is a major time-consuming situation for financial institutions.

As batch models without continuous learning lack the ability of catching the differentiating trends in the data, they cannot provide powerful explanations as continuous learning in the long run. The risk management team only receives the default probabilities as the model output, and not the explanations of features with the changing trends in data. However, the reasons behind the non-performing loans are not explainable to the business experts. When the ML models are easy to interpret and explainable, the risk management team or any other relevant business expert inside the organization can assess the risk and take appropriate business actions. TAZI's NPL solution addresses the significant risk factors, i.e. features of the applicant at the time of the application, and performs an explanatory analysis on the major reasons behind a defaulted loan.

TAZI NON-PERFORMING LOAN SOLUTION

Tazi utilizes the Automated NPL Solution approach shown in Figure 1.

Figure 1: TAZI's Automated NPL Solution Approach

Economic conditions and payment trends change over time, so detecting the changing patterns is crucial to increase the model performance for risk detection models. TAZI's patented continuous ML technology allows models to update continuously so that potential NPL's can be identified better as well as decreasing the model deployment time thanks to its easy-to-use, no-code interface. TAZI's NPL Solution aims to decrease the total NPL amount to directly increase profitability.

The live explanation model provides insights for default micro-segments. A micro-segment of defaults can consist of patterns that businesses cannot directly identify. An example micro-segment could consist of a specific loan purpose such as house debt and low employment length. Business users can plan actions on these default patterns directly from the platform. An example of a successful loan pattern is highlighted in the figure below:
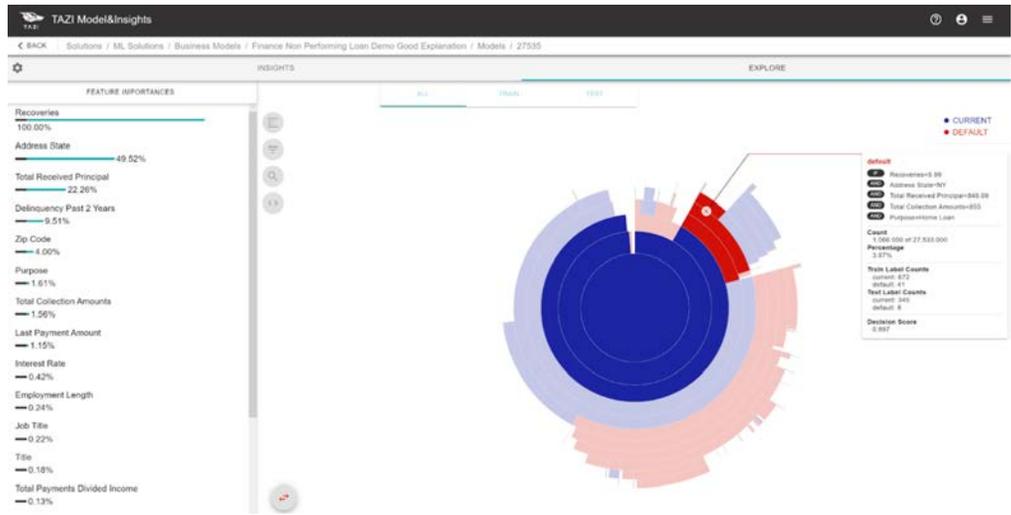
Figure 2: Explainable AI interface showing predicted default loan microsegments (in red) and highlighting a particular micro-segment. The most important features used by the model are sorted on the left.

Following the categorization of the potential borrowers, business experts and executives will be able to see the added revenue from these loans and directly measure the profit gained or risk attained after making the decision of giving loans.

Acceptance and default rates can be observed live directly from the TAZI dashboards as shown in the figures below.
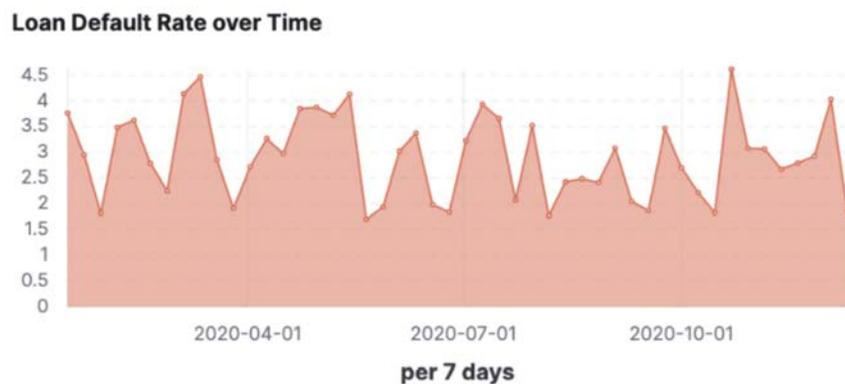

Figure 3: Live dashboard tracks the change in default and acceptance rate.
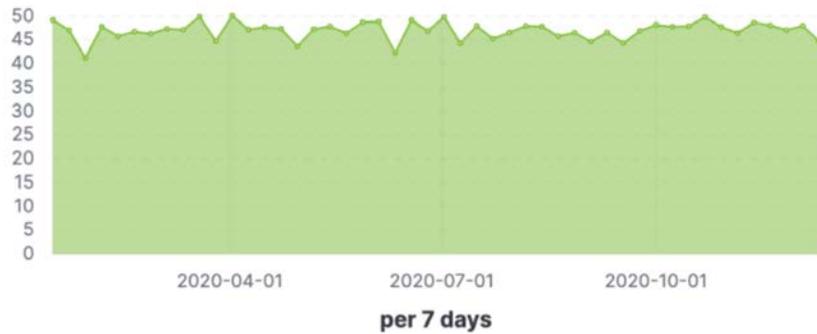
Loan Acceptance Rate over Time

Figure 4: Live dashboard tracks the change in default and acceptance rate.

A detailed periodic review can be presented to the executives. Below, a monthly summary of the loans and profits is exhibited. These dashboards change dynamically when new data flows to TAZI.
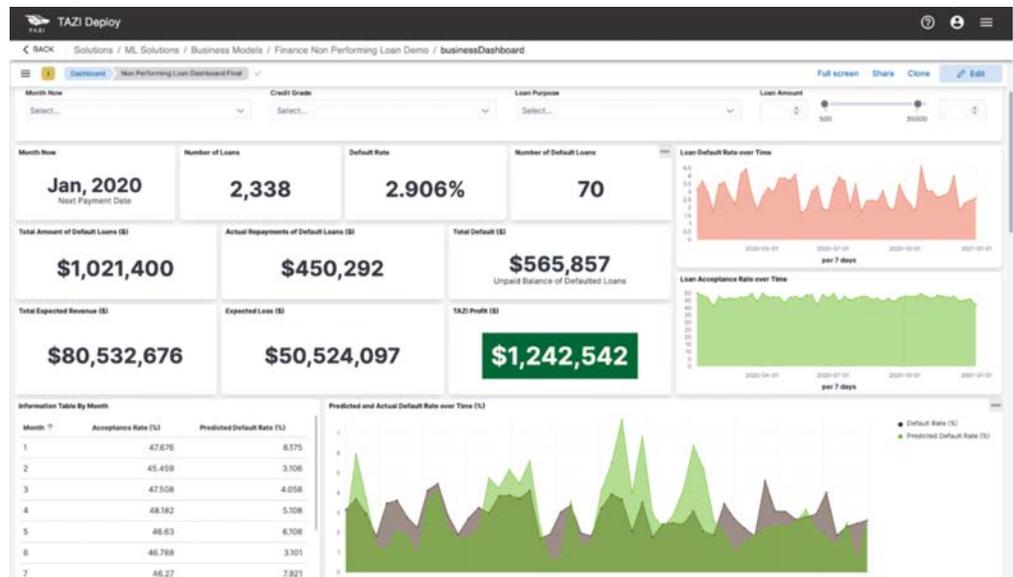

Figure 5: Business users can track the revenue and profit gained from the loans in a specified time period.

In Figure 6, the loan application table is shown. This table allows business users to see which loans are possible defaults. Profits are calculated as revenues gained from successfully repaid applications.

Loan Application Table

27527 documents

	data.ID	data.Loan Amount	data.FICOScore	data.Next Payment Date	predictedlabel	decisionscore
>	62,390,124	$13,725	620	Jan, 2020	default	0.957
>	25,967,179	$16,000	620	Jan, 2020	default	0.952
>	3,932,880	$17,000	775	Jan, 2020	default	0.948
>	6,888,941	$9,000	690	Jan, 2020	default	0.942
>	47,270,202	$15,000	530	Jan, 2020	default	0.938
>	4,276,118	$30,000	620	Jan, 2020	default	0.933
>	14,539,390	$16,150	620	Jan, 2020	default	0.929
>	60,616,278	$24,000	440	Jan, 2020	default	0.926
>	16,461,664	$28,000	775	Jan, 2020	default	0.92

Figure 6: The Loan Application Table

An increase in the average acceptance rate of the customers can shed light on the gained customers who are likely to pay their expenses. Similarly, customers who are not able to pay their expenses can be detected.

Let's say that we have 10,000 loan applicants in total and want to see the distribution of the prediction scores of the model for these applicants. The distribution of default ratios for the same applicant demonstrates the improvement of profits. After sorting the loan applications by their predicted score (Pred. Score) and grouping the applications into 5 groups, we would have the following table:

APPLICATION ANALYSIS TABLE							
#	Count	Total Amount of Loan Applications ($)	Total # of Defaulted App.	Default Ratio	Pred. Score (Avg.)	Acceptance Rate (Training Data)	Acceptance Rate (Model Output)
1	2,000	600,000	20	0.10%	0.50%	75%	87%
2	2,000	540,000	80	0.40%	1.20%	67%	78%
3	2,000	500,000	140	0.70%	1.40%	58%	57%
4	2,000	550,000	240	1.20%	2.50%	44%	38%
5	2,000	450,000	300	1.50%	3.70%	35%	27%

Figure 7: Application Analysis Table

The table above illustrates the contribution of the model's predictions to the profit. This representation allows us to examine the acceptance decisions on the same application, before and after TAZI model implementation. Default ratio is the actual defaulted application ratio whereas the predicted score average is the average default ratio if the model was implemented. With an analysis similar to the table above, it is easy to track the performance of the continuously learning model. The model is able to identify more customers who are likely to pay, or reject customers who are likely to default. In short, the improvement can be tracked by the increase in acceptance rates at the same default rate after TAZI implementation. The decrease in the default rates, when looking at the same acceptance rates, can be observed gradually.

Acceptance rate and default rate have an important relationship: correctly tagging successful defaulted applications yields a lower default rate at the same acceptance rate, and a higher acceptance rate with the same default rate. With the model output, it is possible to see the total profit gained by correctly labeled applications.

Loan Information	
Number of Loan Applications	35,000
Average Loan Amount ($)	18,500.00
Current Default Rate (%)	2.00%
Average Interest Rate (%)	3%
Current Acceptance Rate (%)	45%

Figure 8: Loan Information Table

With the information above, we can calculate the revenue gained by the accepted successful (non-defaulted) applications and the loss generated by the defaulted ones. Revenue and loss obtained from rejected applications are also added to the calculation. This calculation yields a $10,881,238 annual profit. With the TAZI model, defaulted customers can be predicted more accurately,

resulting in increased profit for the organization. The table below has the outputs from the TAZI model, showing the correctly and incorrectly predicted loan applications.

This calculation yields the following revenues and losses as follows, where the positive sign implies revenue and the negative sign implies a loss:

Predicted / Actual	DEFAULT	SUCCESSFUL
DEFAULT	9,712,500	-3,237,500
SUCCESSFUL	-5,710,950.00	13,325,550

Figure 9: Table of Confusion for TAZI's Predictions

Summing up these revenues and losses, we are left with the total profit of the TAZI NPL model: $14,089,600 representing a total of $3,208,363 annual profit increase.

CONCLUSION

TAZI decreases the amount of risk encountered by the financial institution whereas increasing the profits gained by successful loan applications significantly better than traditional ML pipelines by detecting default loans in real-time thanks to its continuous learning technology. Periodic model maintenance and rebuilding phases are a financial burden for the companies due to long rebuilding and maintenance phases. Therefore, TAZI's easy, understandable, continuous AutoML platform lets you increase profits gained from the loans.

To understand and quantify the impact on your book of business, please visit the TAZI Finance Non-Performing Loan web page.

Do you want to learn
- Whether you have sufficient and clean data to predict defaulted loans?
- How you can build your own evolving non-performing loan models within 10-30 days?
- How you can start decreasing NPL amounts in 1-2 months?
- How you can up-skill your business and data teams to adopt machine learning?

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ABOUT TAZI

Artificial intelligence (AI) is a source of both huge excitement and apprehension, transforming enterprise operations today. It is more intelligent as it unlocks new sources of value creation and becomes a critical driver of competitive advantage by helping companies achieve new levels of performance at greater scale, growth, and speed than ever before, making it the biggest commercial opportunity in today's fast changing economy.

TAZI is a leading global Automated Machine Learning product/solutions provider with offices in San Francisco. TAZI is a Gartner Cool Vendor in Core AI Technologies (May 2019) and is considered as "The Next Generation of Automated Machine Learning" by Data Science Central.

WHO WE ARE

Founded in 2015, TAZI has a single mission which is to help businesses to directly benefit from Automated Machine Learning by using TAZI as a superpower, shaping the future of their organizations while realizing direct benefits like cost reduction, increasing efficiency, enhanced (dynamic) business insight, new business (uncovered), and business automation.

WHAT WE OFFER

Through its understandable continuous machine learning from data and humans, TAZI is supporting companies in banking, insurance, retail, and telco industries in making smarter, more intelligent business decisions.

TAZI solutions are based on a most compelling architecture that combines the experiences of 23 patents granted in AI and real-time systems, proven at different global implementations.

Some unique differentiators of TAZI products are:

- Business users can automatically configure custom ML models based on their KPI and the available data. TAZI's Profiler accelerates this process through data understanding and automated cleaning, feature transformation, engineering, and selection capabilities.
- TAZI models learn continuously, and are suitable for today's dynamic, realtime data environments.
- TAZI models are GDPR compliant (no black-box models). They provide an
- explanation in the business domain's terminology for every result they produce.
- TAZI supports multiple (heterogeneous) data sources, i.e.,.: external, batch, streaming, and others.
- TAZI can learn both from human domain experts and from data, which speeds up accuracy improvement.
- TAZI's hyper parameter optimization feature reduces human time spent for model configuration. TAZI products contain algorithms that are developed and coded to be lean, efficient, and scalable.