Development of an Intervened Forecasting Model for Credit Life Cycle Based on a Previous Evaluation

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1. Problem Statement

Before raising the problematic that will be addressed during the research practice, it's considered necessary to define the area where it is framed. Bancolombia counts with a tactic for an integral administration of risks, that points towards the identification, measurement, monitoring and mitigation of the inherent risks of the organization; in order to support the decision making processes and the execution of different strategies [1].

Should be noted that the concept of risk is quite large, for this reason it's consider important to precise the most relevant aspects of the types of risks present in Bancolombia. The risks are understand as the probability of incurring in losses to different reasons:

- Operational risk: caused by failures or weaknesses in the processes, people, systems, or external events.
- Market and liquidity risks: decrease in the value of the investments portfolios, funds or other resources mostly explained by the fluctuation of the interest and exchanges rates.
- Credit risk: when a third party fails to fulfill its obligations partial or totally. This translates in deterioration of the credit quality.

For the investigation purposes the attention will be centered in the credit risk, therefore is pertinent to understand credits and their life cycle. Credit is a privilege that a bank or funding organization gives to a natural or legal person to receive money now with the commitment of paying it in the future. The life cycle has three stages: granting, tracing and recovery. The granting stage involves an evaluation of several factors that accounts for the debtor's ability to pay based on the bank policies already established. The tracing stage has the purpose to supervise the fulfilling of the latent responsibilities of the client with the bank; this process generates collection strategies that meet the needs of the clients increasing the payout odds. Finally, the recovery stage is meet when the client fulfills the totality of the obligations. This is what the bank expects but, sometimes the clients are not able to pay the credit, this is when the credit scale in days past due and could be write off.

The credit risk is controlled with a forecasting model that projects: past-due portfolio (30, 60, 90 and more than 90 days past due), written offs, balance allowance and allowance expense, the last one understood as:

$$E_t = A_t - A_{t-1} + W_t,$$

where

E_t: Actual allowance expense
A_t: Actual allowance
A_{t-1}: Past allowance
W_t: Actual written offs

Detailing the variables from above, an allowance (A) can be understand as a collection of money that tries to lighten the impact in case of default by the third party. On the other hand, a write off (W) is a countable operation that gives treatment to the losses of an amount before considered as an asset, in other words, when a credit is considered unrecoverable.

The model considers tendency and seasonality of the events occurred in the past to forecast the future using Markov chains, it's important to precise that the model has quarterly forecasts.

The model works in a probability space (Ω, F, P) where Ω is the set of outcome, F the set of subsets and P is the probability of A; where A belongs to F. If i is called a state and I is the state space, P_{ij} where i, $j \in I$ is the probability of going from state i to state j [2]. Translating this definition to the specific scenario of the credit life cycle, we start with an initial state that reflect the state of the portfolio past due in the present and based on tendency and a seasonality observed in the past we determine the probability of the credit to move between different days past-due. For example, if we have a credit that has 30 days

past due today what are the chances, based on the observed transition and seasonality rates, that in three months it stays there, or gets totally recovered, or moves to 60 days past due, to 90 days past due, or gets write off.

Even though the model tries to represent the credit life cycle that is not always possible, this is why expert intervention is needed to achieve more accurate projections, foregoing generates a problematic for the bank. This problematic would be approach in the present investigation trying to determine the precision of the actual model and developing an intervene model that lessen the error of the actual one incorporating missing concepts such as macroeconomic variables. Because of the magnitude of the project, the model will be restricted to a specific product of the portfolio, free investment.

2. Objectives

General: Develop an intervened a forecasting model for the credit life cycle concept(s).

Specific:

- Measure the quality of the actual model based on statistical techniques.
- Study different models capable of forecasting in accurate ways.
- Study macroeconomic variables and how to include them in the intervened model.
- Study external variables and the relationship they could have in the forecasts.
- Extract all the information needed from the data bases of the organization.
- Implement an improved model based on the studied models and the available information.
- Measure the discrepancies of the reality and the forecasts obtained with the intervened model.

3. Previous Research

Having in mind that knowing in certain degree the behavior of the credit life cycle in the future can help monitoring the credit risk inherent in the organization, a projection model was developed.In virtually every decision they make, executives today consider some kind of forecast; predictions are no longer luxuries, but a necessity [3]. Before establishing the model, there was a previous study of the accuracy, computation cost, and generality of the forecasting existing methods in addition to a review of the state of art in projection models for the portfolio life cycle. Even though the information and bibliography are very limited due to the security and privacy of banks affairs and methodologies, there are certain concepts, as the past due portfolio, that has been more explore. One of the most common tool used in portfolio forecasting are the role rates models as statistics [4]. As specified in Figure 7 of [4] the Markov chains can captured the dynamics of the past due portfolio where state transitions are model by historical transitions probabilities. Despite the low evidence of how to model the other concepts in the credit life cycle, a Markov chain forecasting model was developed hoping to obtain accuracy projections for the other concepts as these largely depends on the past due portfolio by range of default. After testing the model and noticing discrepancies and external parameter was included, this parameter is moved in a very empirical way based on expertise. The no automated, inconsistently and not established way of functioning raises alerts that suggests a prompt evaluation.

4. Justification

It is evident that no forecasting model is ideal for representing reality in a perfect way, yet is possible to correct weaknesses in the actual model to have more accurate projections.

The forecasting model is crucial for the bank since it is the sustain for the decisions taken in the management of the portfolio. To be able to forecast the dynamic of the credit life cycle allows not only the management and coverage of the credit risk but to obtain greater profitability. When the past-due portfolio is overestimated, the allowances are too and therefore the allowance expense will be greater; this means that the bank has extra allowance to cover an inferior risk, which impedes the obtaining of probability with that extra money. The contrary case is also unwanted because if the allowance in underestimated the allowance expense will be less and there would be more money able to invest and obtain more profit with, but this scenario is to risky for the bank which is in reality expose to a greater risk that is not being covered with enough allowance.

For the reasons explain above, we can conclude that the forecasting model is the basis for implementing different strategies for the uptake and laying of bank's portfolio. All the action plans on how to invest money, recover past-due portfolio and written offs and how to implement policies for ranting credit are effects of the forecasts ensuing of the actual model. The solution of the problematic has also academic purposes; the solution would be based on a series of concept learned in the university and applied in a financial field that has little bibliographic record because of the confidentiality of the information the banks uses.

5. Scope

The project scope is quite large due to the variety of models that can be implemented and the variables that can be used. The actual model only contains internal variables, but excludes all macroeconomic variables; this means that

different combination of variables creates different models and testing the accuracy of each model is a whole new problem. Besides the actual model forecasts around five different concepts with the same model structure, but may be possible that different forecasting models should be used when projecting the different concepts, and that is also another pretty large problem. It's worth remembering that the problem was restricted to one (free investment) of many products the bank offers so the problem will be faced by evaluating the behavior of that product and determine a suitable forecasting model for it; this raises a big question Would the model performed well when forecasting in a different product?

As you could see the scope of the project cannot be accomplished during this research, for this reason it is considered necessary to delimit the scope of the problem to what's think the most important. In consequence an initial understand and diagnosis of the model is vital to guide the research. The diagnosis will be made in terms of the error existing between the forecast and the reality, based on this error the model would be intervened for the most/more critical concept(s) using most significant macroeconomic variables, proposing a model preferably easy to replicate for other products, lastly the intervened model would be tested in terms of error excepting to overcome the actual model.

6. Methodology

The methodology will contain different stages; the fist will consist on a diagnosis of the actual model, for the diagnosis real and projected data should be extracted and compare during a significant period of time. The second stage consist on a constant review of the state of art of the most accurate forecasting models and techniques used in similar scenarios, also there would be a studying period of the variables never involved in the model and the effect they could have. The third stage will consist on a collection of the information needed and the implementation of the model or different models in software preferably used in the bank. The last stage will focus on the testing of accuracy of the model or models implemented.

To achieve significant results every 15 days meetings are proposed to evaluate the results obtained, solve concerns and guide the research.

7. Timetable

Table 1 contains a more detailed list of activities considered necessary to achieve the objectives established above, in addition to the reports submission and presentation dates.

Table 1: Activity schedule

Activity	Duration	Status
Study the forecasting model and impacts	2 weeks	finished
Write the proposal report	3 days	finished
Submission proposal report	January 29	finished
Preparation of proposal presentation	2 days	started
Proposal presentation	February 12	pending
Historical data collection	3 weeks	started
Statistical diagnosis of the model	2 weeks	started
Preparation for progress presentation	1 week	pending
Progress presentation	April 8	pending
Study of macroeconomic variables	2 weeks	pending
Model/Models implementation	2 weeks	pending
Evaluation of the intervened model	3 days	pending
Write final report	1.5 weeks	pending
Submission final report	May 20	pending
Preparation of final report	1 week	pending
Final project presentation	June 7	pending

Table 2: Research costs

Concept	Description	Price
Tutor advice	biweekly meetings of 2 hours	$720.000 COP
Class fee	cost per class in EAFIT University	$2'216.000 COP
Lenovo X240	price consulted in Amazon	$666 USD
Data Base	approx 50.000 entries for 4 months	$4'000.000 COP
SAS Analytic Pro	1 year license price consulted in [5]	$8,700 USD
Computer usage	4 hours per week	$250.000 COP
Total		$38'093.000 COP

8. Budget

Table 2 summarizes the costs per concept that are initially considered for approaching and developing the problematic embodied herein.

The costs of the investigation will be totally covered by Bancolombia and EAFIT University except for the class fee, that was covered by the student Carolina Gonzalez-Restrepo. Bancolombia will also provide and covered the cost in case an extra data base is needed.

9. Intellectual Property

The intellectual property is understood as " set of rights the authors or inventors have over their creations", under the Regulation of Intellectual Property of EAFIT University [6]. It's considered important to precise the present research is not approach individually, by the contrary, the tutor will continuously accompany the research. Is for his reason that the intellectual property belongs to all the involved in this investigation project.. If during the research there is knowledge shared by someone else that hasn't been mentioned before, this person will have rights over the research. Likewise, EAFIT University and Bancolombia

will have part of the intellectual property due to the financial aid they provide.

References

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