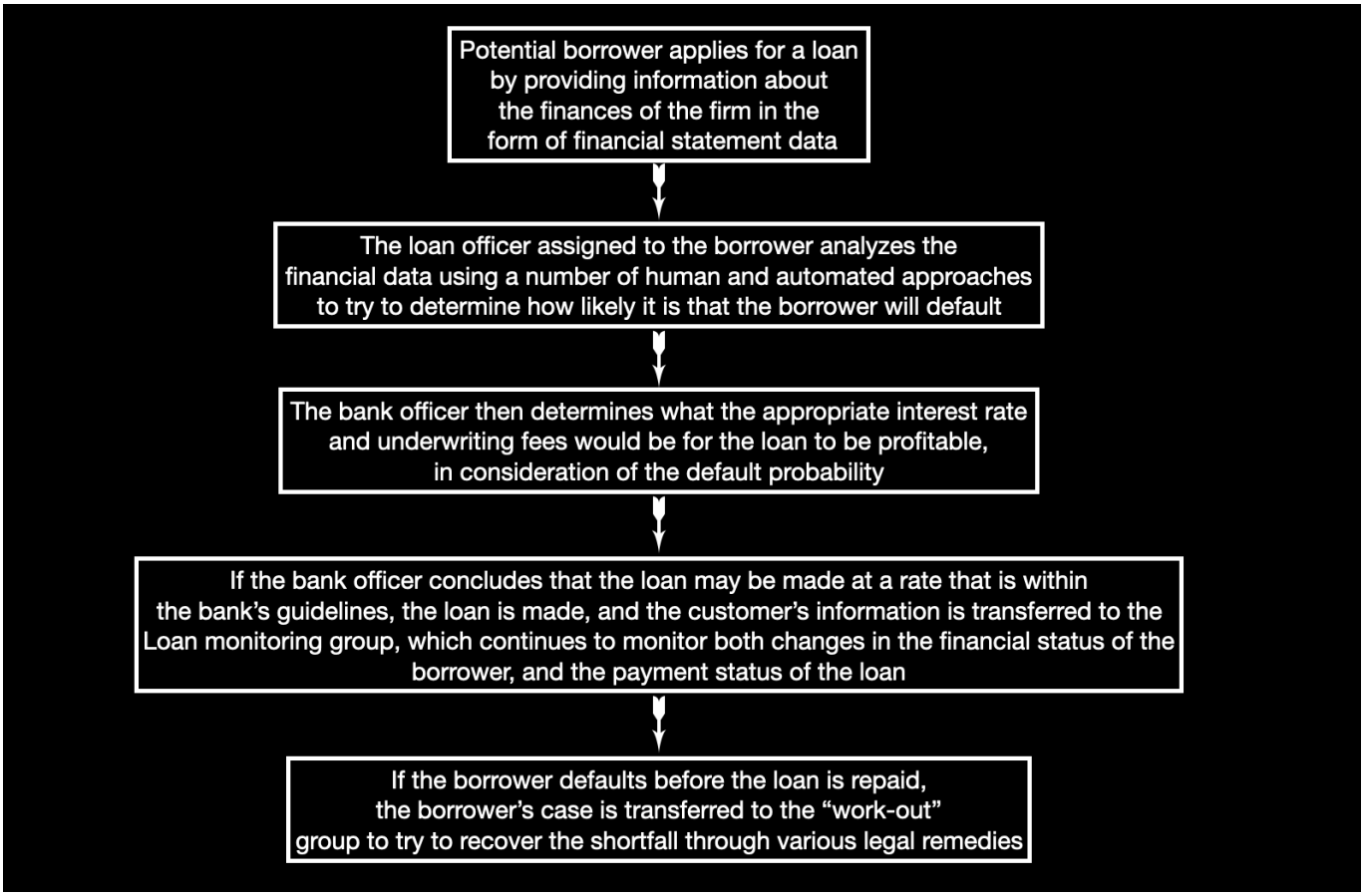
Improving Loan Underwriting at Banca Massiccia

Business Case Definition

Banca Massiccia, a large Italian bank, has been making loans to businesses for many years, and has experimented with different approaches to underwrite these loans, including statistical models of default. Their vision is to use risk-based pricing to set interest rates and underwrite fees for borrowers. However, this vision comes with understandable obstacles, such as how to optimize its underwriting process using the power of machine learning so that the bank can produce the probability of default (PD) for prospective borrowers both efficiently and accurately, as well as set the price and interest rates based on heterogeneous risks. Banca Massiccia would like to leverage the data it has accumulated over the past several years and better predict the probability that a potential borrower will default on a principal or interest payment for a prospective loan over the next 12 months. In this proposal, we outline a project in which we will develop a state-of-the-art machine learning algorithm for Banca Massiccia, which will employ innovative approaches to understanding Banca Massiccia's clients and making PD predictions based on client features.

The basics of a transaction flow is as follows:



Dataset Overview

Variable Name	Description
id	firm identifier

Variable Name	Description
HQ_cities	city of the main branch
legal_struct	legal structure
ateco_sector	industry sector code
fs_year	year of the financial statement
asst_intang_fixed	intangible assets
asst_tang_fixed	tangible assets
asst_fixed_fin	financial assets
asst_current	current assets
AR	account receivable
cash_and_equiv	cash & equivalent holdings
asst_tot	total assets
eqyt_tot	total equity
eqyt_corp_family_tot	total equity for entire group ("family")
liab_lt	long-term liabilities
liab_lt_emp	long-term liab to employees
debt_bank_st	short-term bank debt
debt_bank_lt	long-term bank debt
debt_fin_st	short-term debt other
debt_fin_lt	long-term debt other
AP_st	short-term accounts payable
AP_lt	long-term accounts payable
debt_st	short-term debt
debt_lt	long-term debt
rev_operations	operating revenue
COGS	cost of goods sold
prof_operating	operating profit
goodwill	goodwill
inc_financing	financial income
exp_financing	financial expense
prof_financing	financial profit

Variable Name	Description
inc_extrard	extraordinary income
taxes	taxes
profit	net profit
days_rec	days receivable
ebitda	earnings before interest, taxes, depreciation, and amortization
roa	return on assets
roe	return on equity
wc_net	net working capital
margin_fin	equity - fixed assets
cf_operations	operating cashflow

Project Description

This project is aimed at helping Banca Massiccia better predict the probability of default based on a client's features. We will focus on two main objectives:

1. Exploratory analysis of borrower segments
2. Development of a machine learning algorithm for predicting probability of default (PD)

We feel that these two branches of the project will combine to give Banca Massiccia a better understanding of their customers' financial behaviors and performances and will allow them to deliver a more personalized pricing strategy.

In objective 1, **Borrower Insights**, we will perform a borrower segmentation analysis on data provided by Banca Massiccia. We will first perform an in-depth analysis of the borrower's data in which we will assess data quality and completeness, before performing preliminary exploratory analyses, looking for relationships between financial behavior, performance features (e.g., equity, debt, and profit) and default behavior (e.g., default date). We will then select a subset of features that have the most utility for separating borrowers into default and non-default segments. To achieve this we will take an unsupervised approach, exploring several clustering methodologies before determining which has the most promise for this particular dataset. Notice that when performing cluster analysis, the number of clusters should be set as 2 (e.g., default vs. non-default, if the default happens within 12 months after the financial statement date then the borrower is defined as default, otherwise defined as non-default).

In objective 2, **Probability of Default (PD) Prediction**, we will focus on building a SOTA machine learning algorithm that can be used to predict borrowers' probability of default on principal and interest payments over the following 12 months. We plan to use a neural network model in a supervised setting, in combination with the borrower feature subsets and default variables identified in Objective 1. However, through the course of our research for this project we may find that a different approach may be more appropriate. We have, therefore, broken this project into two discrete phases: research and building. The research phase will involve exploring various loan default prediction methods, with the intention to gain enough knowledge to

choose a single best option for the build phase, where we will productionise an algorithm that runs on the borrowers' features and returns the probability of default.

We outline the plan for this project below.

Project Proposal: Borrower Insights and Default Prediction

Objective: This project is aimed at developing a machine learning algorithm that predict the probability of default on a principal or interest payments for a prospective loan over the next 12 months

-- **Objective 1 : Borrower Insights**

Milestone	Work Carried Out	Outcome/Deliverables	Completion Date
Milestone1	• **Exploratory Analysis** • We will explore the data available to support the project. • We will perform a preliminary analysis with a goal of identifying a subset of features that are best-suited for cluster analysis in Milestone 2.	• A report showing the initial findings of relationships between features. • A list of features to use for clustering.	End of Week 5
Milestone2	• **Cluster Analysis** • Using the learnings from Milestone 1, we will experiment with various clustering algorithms. • The best candidates will be selected for further improvements.	• A Github repository containing python code driving a segmentation model. • A report highlighting findings.	End of Week 6

-- **Objective 2: PD Prediction**

Milestone	Work Carried Out	Outcome/Deliverables	Completion Date
Milestone3	• **Research** • Examine the data available to identify a feature space to use.	• A report showing initial findings of possible approaches to the PD prediction	End of Week 7

Milestone	Work Carried Out	Outcome/Deliverables	Completion Date
Milestone4	• **Build & Evaluate** • We will focus on building a neural network model for predicting borrower's probability of default, and training it on the existing dataset. • Evaluate the model performance with various metrics (e.g., precision, recall, roc, etc.)	• Deployed machine learning algorithms that trained on borrower features. • A demonstration outlining experimental approach and deployment specifications. • A Github repo containing all code used.	End of Week 8