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LITERATURE SURVEY ON

**Smart Lender-Applicant Credibility
Prediction for Loan Approval**

**Based on: Applied Data Science
(ADS)**

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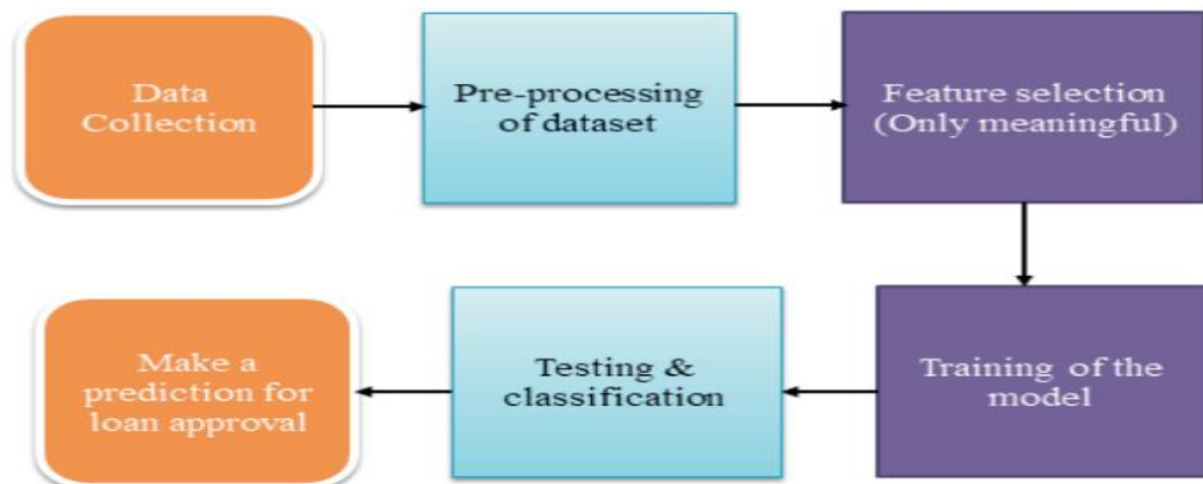
Smart Lender-Applicant Credibility

Prediction for Loan Approval

LITERATURE SURVEY

A recent development of data science techniques and data mining has led to an interest of implementing these techniques in various fields. The banking sector is no exclusion and the increasing requirements towards financial institutions to have robust risk management has led to an interest of developing current methods of risk estimation. Potentially, the implementation of data science techniques could lead to better quantification of the financial risks that banks are exposed to. Within the credit risk area, there has been a continuous development of the Basel accords, which provides frameworks for supervisory standards and risk management techniques as a guideline for banks to manage and quantify their risks.

From Basel II, two approaches are presented for quantifying the minimum capital requirement such as the standardized approach and the internal ratings based approach (IRB). There are different risk measures banks consider in order to estimate the potential loss they may carry in future. One of these measures is the expected loss (EL) a bank would carry in case of a defaulted customer. One of the components involved in EL estimation is the probability if a certain customer will default or not. Customers in default means that they did not meet their contractual obligations and potentially might not be able to repay their loans.



Thus, there is an interest of acquiring a model that can predict defaulted customers. A technique that is widely used for estimating the probability of client default is Logistic Regression. In this thesis, a set of machine learning methods will be investigated and studied in order to test if they can challenge the traditionally applied techniques.

A prediction is a statement about what someone thinks will happen in the future. People make predictions all the time. Some are very serious and are based on scientific calculations, but many are just guesses. Prediction helps us in many things to guess what will happen after some time or after a year or after ten years. Predictive analytics is a branch of advanced analytics that uses many techniques from data mining, statistics, modeling, machine learning, and artificial intelligence to analyze current data to make predictions.

This literature review helps us carry out our work and propose a reliable bank loan prediction model. Manjeet et al (2018) there are seven types of variables that may influence consumer loan default; consumer's annual income, debt-income ratio, occupation, home ownership, work duration and whether or not consumer possesses a saving/checking account.

In a work by Steenackers and Goovaerts, the key factors that may influence loan default are borrower's age, location, resident/work duration, owner of phone, monthly income, loan duration, whether or not applicant works in a public sector, house ownership and loan numbers. Another study by Ali Bangher pour on a large dataset within the period of 2001-2006 indicated that loan age was the most important factor when predicting loan default while market loan-to-value was the most effective factor for mortgage loan applications.

In addition to identifying factors that may influence loan default, there is also a need to build robust and effective machine learning models that can help capture important patterns in credit data. The choice of model so great importance as the chosen model plays a crucial role in determining accuracy, precision and efficiency of a prediction system. Numerous models have been used for loan default prediction and although there is no one optimal model, some models definitely do better than others. In 2019, Vimala and Sharmili proposed a loan prediction model using Support Vector Machines(SVM) methods. Naïve Bayes, an independent speculation approach, encompasses probability theory regarding the data classification. On the other hand, SVM uses statistical learning

model for classification of predictions. Dataset from UCI repository with 21 attributes was adopted to evaluate the proposed method. Experimentations concluded that, rather than individual performances of classifiers (NB and SVM), the integration of NB and SVM resulted in an efficient classification of loan prediction.

In 2019, Jency, Sumathi and Shiva Sri proposed an Exploratory Data Analysis(EDA) regarding the loan prediction procedure based on the client's nature and their requirements. The major factors concentrated during the data analysis were annual income versus loan purpose, customer's trust, loan tenure versus delinquent months, loan tenure versus credit category, loan tenure versus number of years in the current job, and chances for loan repayment versus the house ownership. Finally, the outcome of the present work was to infer the constraints on the customer who are applying for the loan followed by the prediction regarding the repayment. Further, results showed that, the customers were interested more on availing short-tenure loans rather than long-tenure loans.

In 2019, Supriya, Pavani, Saisushma, Vimala Kumari and Vikas presented a ML based loan prediction model. The modules in the present approach were data collection and pre-processing, applying the ML models, training followed by testing the data. During the pre-processing stage, the detection and removal of outliers and imputation removal processing were carried out. In the present method, SVM, DT, KNN and gradient boosting models were employed to predict the possibilities of current status regarding the loan approval process. The conventional 80:20 rule was adopted to split the dataset into training and testing processes. Experimentation concluded that, DT has significantly higher loan prediction accuracy than the other models.

In 2017, Goyal and Kaur presented a loan prediction model using several Machine Learning (ML) algorithms. The dataset with features, namely, gender, marital status, education, number of dependents, employment status, income, co applicant's income, loan amount, loan tenure, credit history, existing loan status, and property area, are used for determining the loan eligibility regarding the loan sanctioning process. Various ML models adopted in the present method includes, Linear model, Decision Tree (DT), Neural Network (NN), Random Forest (RF), SVM, Extreme learning machines, Model tree, Multivariate Adaptive Regression Splines, Bagged Cart Model, NB and TGA.

When evaluated these models using Environment in five runs, TGA resulted in better loan forecasting performance than the other methods.

In 2016, Aboobyda Jafar Hamid and Tarig Mohammed Ahmed presented a loan risk prediction model based on the data mining techniques, such as Decision Tree (J48), Naïve Bayes (NB) and BayseNet approaches. The procedure followed was training set preparation, building the model, Applying the model and finally. Evaluating the accuracy. This approach was implemented using Weka Tool and considered a dataset with eight attributes, namely, gender, job, age, credit amount, credit history, purpose, housing, and class. Evaluating these models on the dataset, experimental results concluded that, J48 based loan prediction approach resulted in better accuracy than the other methods.

Variable	Description
Loan_ID	Unique Loan ID
Gender	Male/ Female
Married	Applicant married (Y/N)
Dependents	Number of dependents
Education	Applicant Education (Graduate/ Under Graduate)
Self_Employed	Self employed (Y/N)
ApplicantIncome	Applicant income
CoapplicantIncome	Coapplicant income
LoanAmount	Loan amount in thousands
Loan_Amount_Term	Term of loan in months
Credit_History	credit history meets guidelines
Property_Area	Urban/ Semi Urban/ Rural
Loan_Status	Loan approved (Y/N)

In 2016, Kacheria, Shivakumar, Sawkar and Gupta suggested a loan sanctioning prediction procedure based on NB approach integrated with K-Nearest Neighbor (KNN) and binning algorithms. The seven parameters considered were income, age, profession, existing loan with its tenure, amount and approval status. The sub-processes include, Preprocessing (handling the missing values with KNN and data refinement using binning algorithm), Classification using NB approach and Updating the dataset frequently results in appropriate improvement in the loan prediction process. Experimentation put-forth the conclusion that, integration of KNN and binning algorithm with NB resulted in improved prediction of loan sanctioning process.

In 2016, Goyal and Kaur suggested an ensemble technique based loan prediction procedure for the customers. The sub processes in the present method includes, data collection, filtering the data, feature extraction, applying the model, and finally analysis the results. The various loan prediction procedures implemented in the present method were Random Forest (RF), SVM and Tree model with Genetic Algorithm (TGA). The parameters considered for evaluating the models were accuracy, Gini Coefficient, Area Under Curve (AUC), Receiver Operating Curve (ROC), Kolmogorov - Smirnov (KS) Chart, Minimum Cost - Weighted Error Rate, Minimum Error Rate, and K-Fold Cross Validation parameters. Experimentation outcome concluded that the integration of three methods (RF, SVM and TGA) resulted in improved loan - prediction results rather than individual method 's prediction. In 2006, Sudhamathy suggested a risk analysis method in sanctioning a loan for the customers using R package. The various modules include data selection, pre-processing, feature extraction and selection, building the model, prediction followed by the evaluation. The dataset used for evaluation in this method was adopted from UCI repository. To fine tune the prediction accuracy, the pre-processing operation includes the following sub-processes: detection, ranking and removal of outliers, removal of imputation, and balancing of dataset by proportional bifurcation regarding testing and training process.

Further, feature selection process improves the prediction accuracy. When evaluated, the DT model resulted in 94.3% prediction accuracy. The process of analyzing data from different perspectives and extracting useful knowledge from it. Tithe core of knowledge discovery process. The various steps involved in extracting knowledge from raw data. Different data mining techniques include classification, clustering, association rule mining, prediction and sequential patterns, neural networks, regression etc. Classification is the most commonly applied data mining technique, which employs a set of pre-classified examples to develop a model that can classify the population of records at large. Fraud detection and credit risk applications are particularly well suited to classification technique. This approach frequently employs Decision tree based classification Algorithm. In classification, a training set is used to build the model as the classifier which can classify the data items into its appropriate classes. A test set is used to validate the model.

Further works on loan approval prediction models are given as follows:

TITLE 1: Improving Information Quality in Loan Approval Processes for Fair Lending and Fair Pricing

AUTHOR: M. Cary Collins

YEAR: 2013

DESCRIPTION: Bank data management on loan approval processes has great room for improvements of information quality and data problems prevention especially with regards to fair lending and fair pricing practices. They first reviewed briefly typical data collection protocols deployed at many financial institutions for loan approval and loan pricing. Federal regulations mandate portions of these data protocols. While discussing the data capture and analysis for fair lending, they illustrated some initial key steps currently needed for improving information quality to all parties involved.

TITLE 2: Loan Credibility Prediction System Based on Decision Tree Algorithm

AUTHOR: Sivasree M S, Rekha Sunny T

YEAR: 2015

DESCRIPTION: Data mining techniques are becoming very popular nowadays because of the wide availability of huge quantity of data and the need for transforming such data into knowledge. Data mining techniques are implemented in various domains such as retail industry, biological data analysis, intrusion detection, telecommunication industry and other scientific applications. Techniques of data mining are also be used in the banking industry which help them compete in the market well equipped. In this paper, they introduced a prediction model for the bankers that will help them predict the credible customers who have applied for a loan. Decision Tree Algorithm is being applied to predict the attributes relevant for credibility. A prototype of the model has been described in this paper which can be used by the organizations for making the right decisions to approve or reject the loan request from the customers.

TITLE 3: Loan Approval Prediction based on Machine Learning Approach

AUTHOR: Kumar Arun, Garg Ishan, Kaur Sanmeet

YEAR: 2016

DESCRIPTION: With the enhancement in the banking sector, lots of people apply for bank loans but the bank has its limited assets which it grants to only limited people, so finding out to whom the loan can be granted is a typical process for the banks. So, in this paper, they tried to reduce this risk by

selecting the safe person so as to save lots of bank efforts and assets. It was done by mining the previous records of the people to whom the loan was granted before and on the basis of these records the machine was trained using the machine learning model which gave the most accurate result. The main goal of this paper is to predict if loan assignment to a specific person will be safe or not. This paper has into four sections (i) Collection of data (ii) Comparing the machine learning models on collected data (iii) Training the system on most promising model (iv) Testing the system.

