Improving Over Indebtedness in Singapore

Borrowers Exploitation by Unlicensed Moneylender

Executive Summary

Issue
- COVID-19 has put a strain on financial health and in 2020, 989 unlicensed moneylending cases and 3,344 harassment cases recorded

Context
- Stringent assessment and relatively slow loan approval process by banks and licensed moneylenders deter potential borrowers

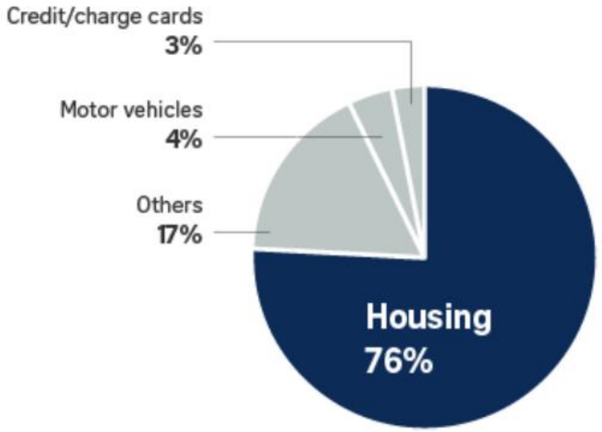
Pain point
- Credit analysts assess risk by thoroughly analysing a borrower’s capability to repay a loan that is tedious and time-consuming

Solution
- Include automated risk rating based on probability of default using borrowers’ personal and loan historical information

Objective
- Differentiate between loan applications that are ready for decision and those that require more documentation thus reducing decision time and increase approval rate

Source: Kaggle and Department of Statistics, Singapore |
Prepared by: Alvin Lie

Families could face difficulty with home loan payments



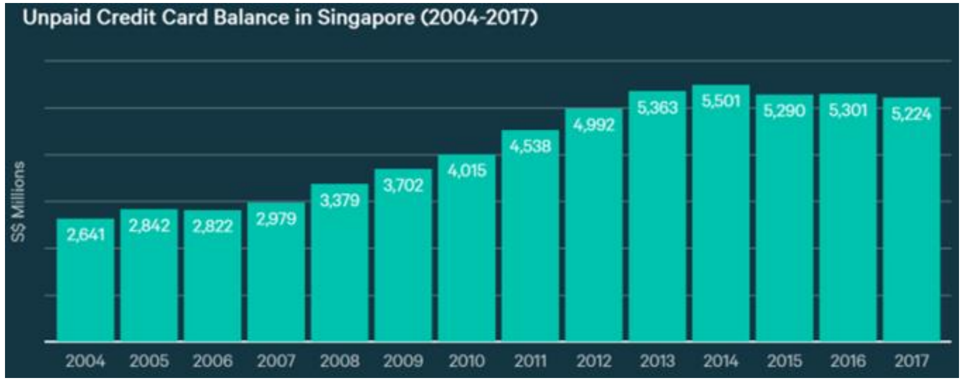
Breakdown of Outstanding Household Debt

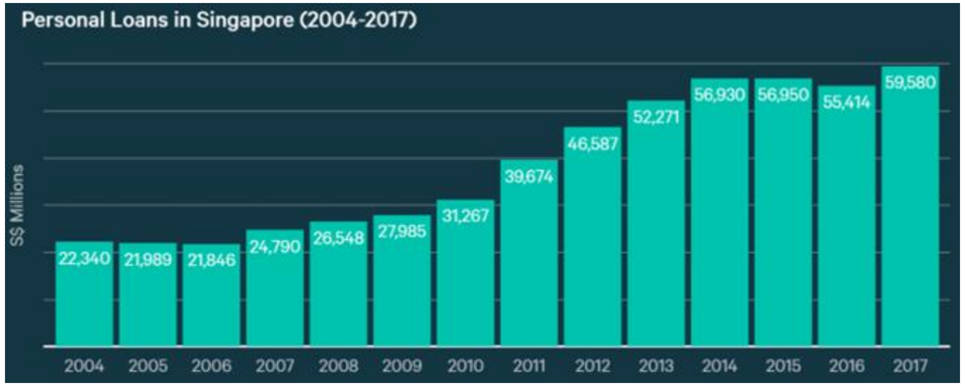
Credit card charge-off rate rose from 5.9% to 9.1% from last year

- COVID-19 has put a strain on financial health, impacting families' ability to pay their housing loans
- Credit card charge-off rate measures bad debt written off during the year against the average rollover balance, and is a leading indicator for the credit quality of housing loans
- A borrower is likely to miss payments for their credit card bills in the initial period of financial distress

Potential business lost to unlicensed moneylenders

- Stringent assessment and relatively slow loan approval process by banks and licensed moneylenders deter potential borrowers
- Unlicensed moneylenders offer quick approval and hassle-free applications
- Other than house loan payments, borrowers may borrow to fund educational needs, a medical emergency or to tide over short-term cash flow challenges for a small business

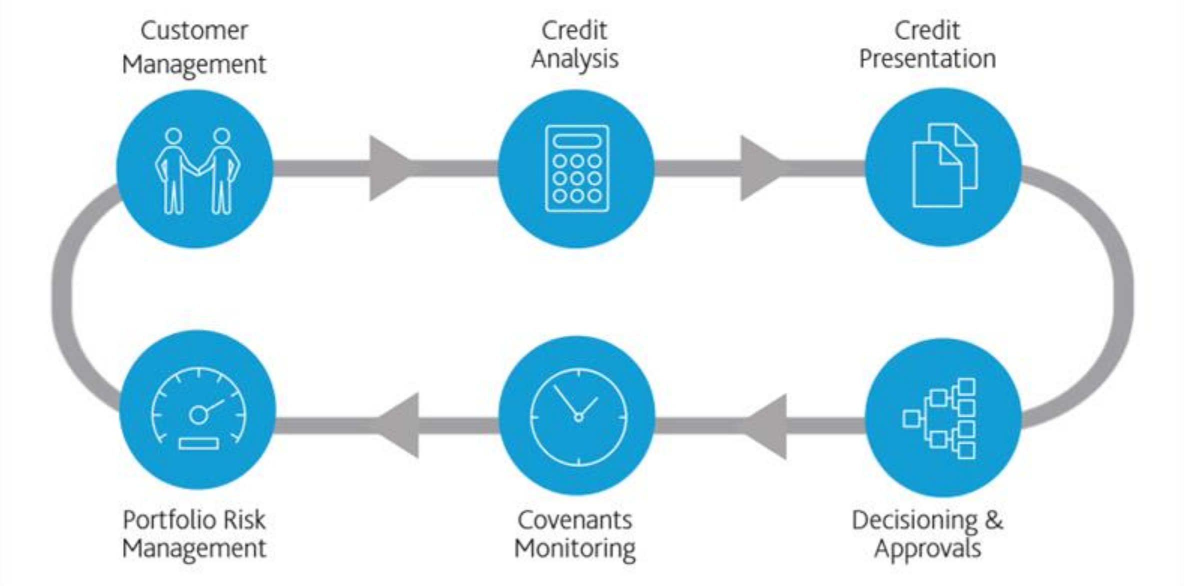




Credit card debt and personal loans have been the fastest growing categories of consumer debt with potential market size of **S$65B**

Loan process automation for quick approval

- Credit analysis can include automated risk rating based on probability of default and give more time back to the analyst to perform their risk assessment work
- Automation of the lending process increase efficiency and reduce decision time
- Differentiate between loan applications that are ready for decision and those that require more documentation



Value for all stakeholders

Society

- Improve financial well-being of those in need
- Reduce societal issues caused by unlicensed moneylender

Bank/Licensed moneylender

- Increase productivity of credit analyst
- Competitive approval process

Borrower

- Reduced waiting time of loan process
- Better alternative to unlicensed moneylender

Success is defined by 2 measurable factors

Short-term key success factor

Increase the loan approval rate by 50% for credit analysts over a half-year period

Long-term key success factor

Decrease the number of credit default by 80% within 4 years

The dataset will be used to predict credit default risk

- 32,581 borrowers’ personal and loan information as 12 indicators

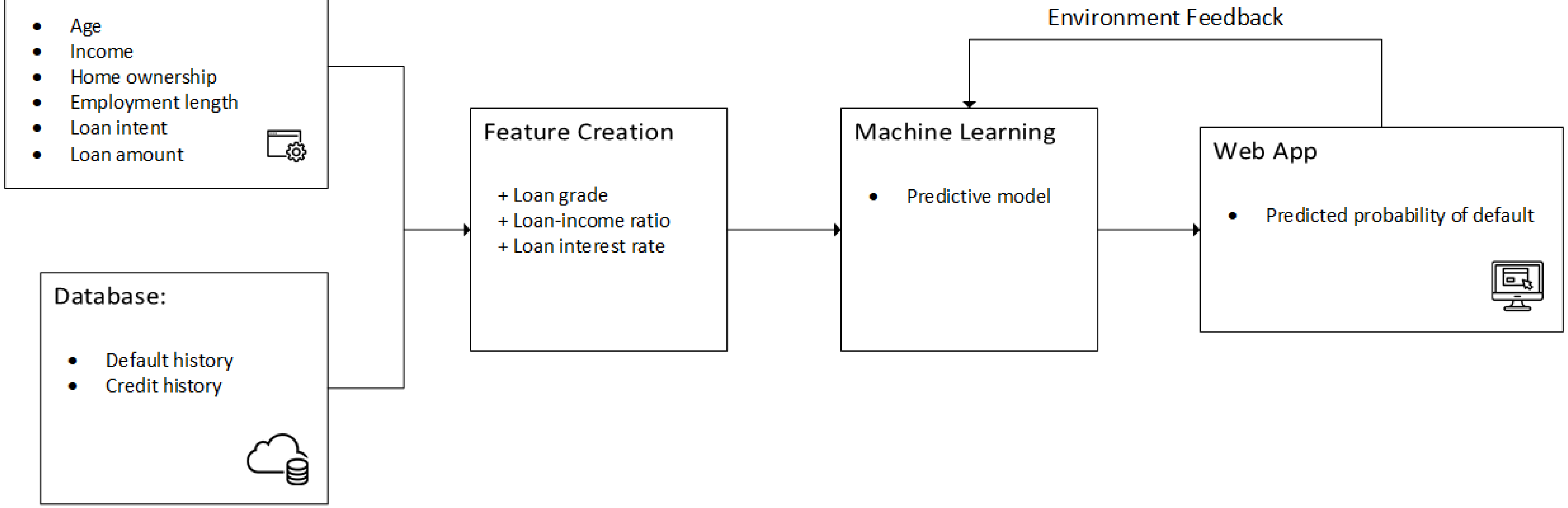
	Age	Income	Loan Amount	Interest Rate	Loan Grade	Credit History	Default History	Loan Status
Description	Age of the borrower in years	Annual income in dollars	Amount of loan in dollars	Interest rate of loan in percentage	A function of variables to grade the loan from ‘A’ to ‘G’	The number of years since the loan was taken	‘Y’ for defaulted before or ‘N’ for never defaulted	‘0’ for non-default or ‘1’ for default

	Home Ownership	Employment Length	Loan Intent	Loan-Income Ratio
Description	Current status of home ownership: ‘own’, ‘rent’ or ‘mortgage’	Number of years in employment	Intended use for loan: ‘education’, ‘medical’, ‘venture’, ‘home improvement’, ‘personal’ or ‘debt consolidation’	Ratio of loan to annual income

Interpretation of the indicators

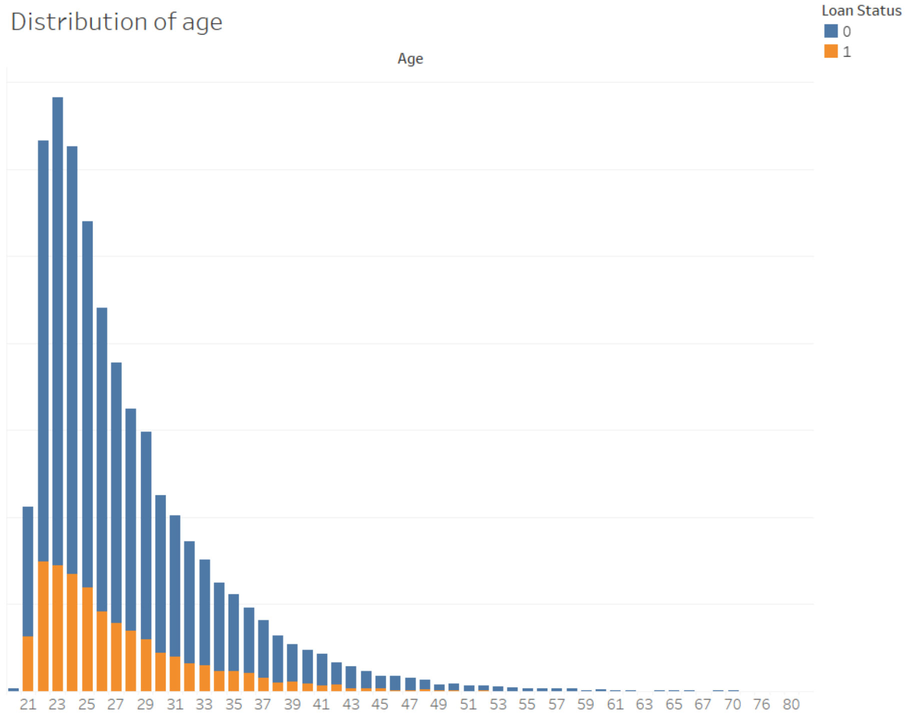
- Age of borrower: a productive age range is to be identified as it affects their income
- Income: a higher income increases the probability of repayment of the loan
- Loan amount: the loan amount affects the interest rate charged to the borrower
- Interest rate: higher interest rate indicates higher risk of the loan
- Loan grade: grade is determined by a number of factors such as loan amount and interest rate
- Credit history: higher number of years since loan was taken indicates better repayment history
- Default history: borrower that has defaulted before may increase the probability of credit default
- Loan status: current status of their loan will be used to predict the probability of default for future loans
- Home ownership: whether they own, rent or mortgage their home shows their financial liability
- Employment length: length of employment may indicate the stability of their income
- Loan intent: the intention of their loan may affect future income and determines the loan's risk
- Loan-income ratio: higher ratio indicates over-borrowing and increases credit default risk

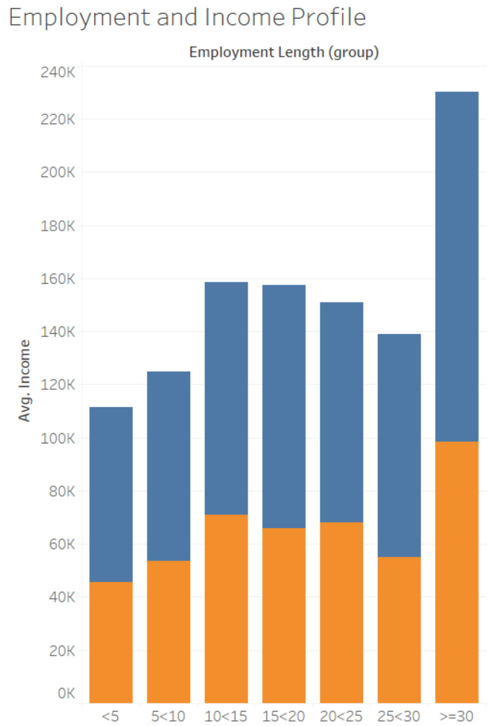
Data Flow Diagram



Source: Kaggle and Department of Statistics, Singapore |
Prepared by: Alvin Lie

Exploration of the indicators

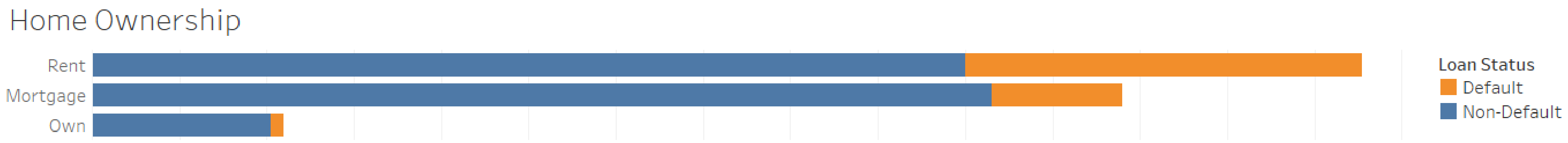




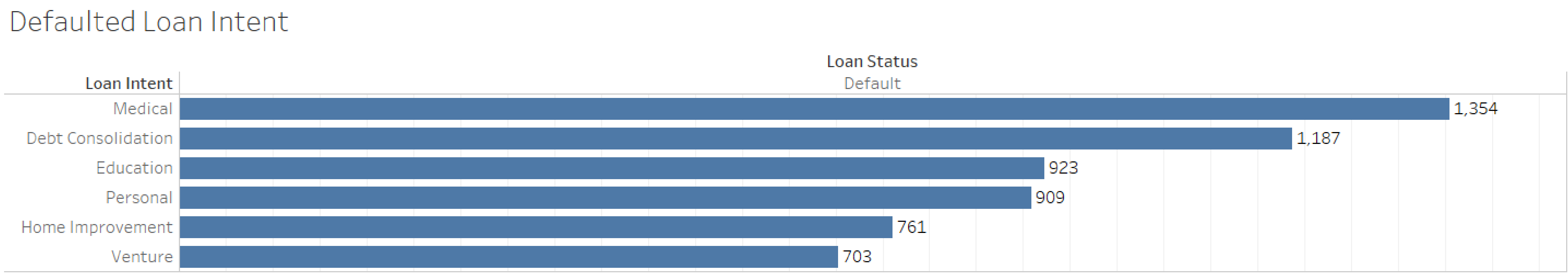
- The age distribution of our dataset is right-skewed with the majority of the borrowers in their 20s. Borrowers in their 20s have a higher percentage of defaulters compared to older age groups
- Despite earning higher average income, borrowers that have been employed for 30 years or more have higher number of defaulters

Source: Kaggle and Department of Statistics, Singapore |
Prepared by: Alvin Lie

Exploration of the indicators

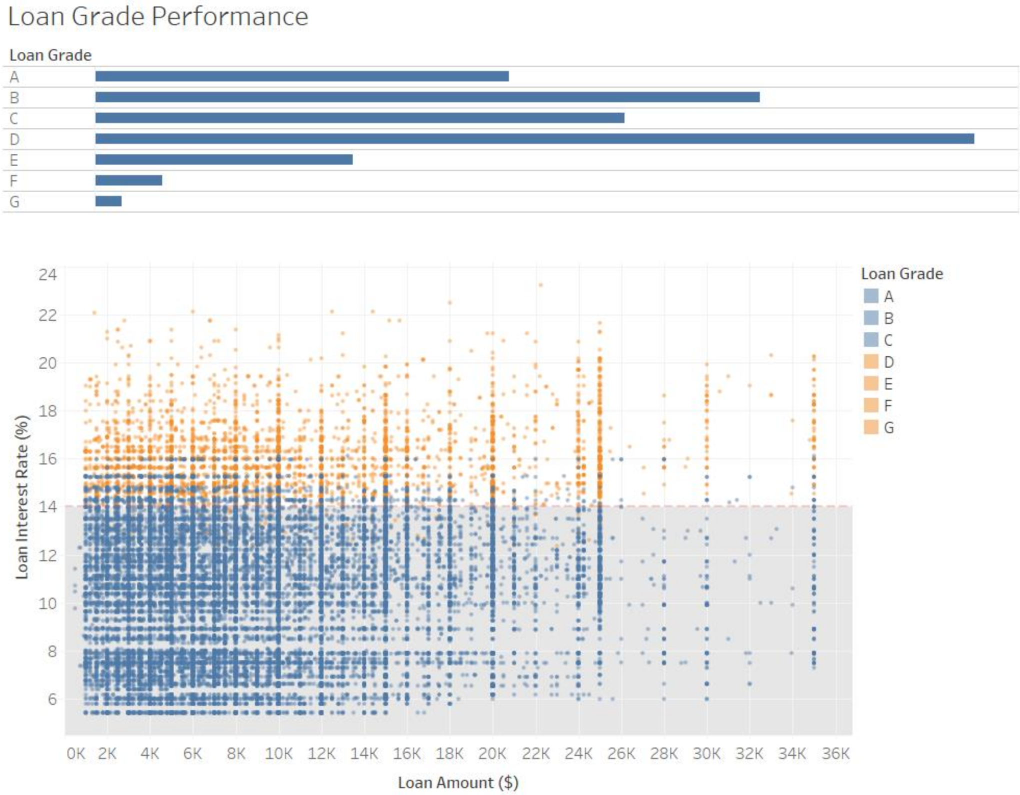


- Borrowers that rent or mortgage their homes are more likely to default



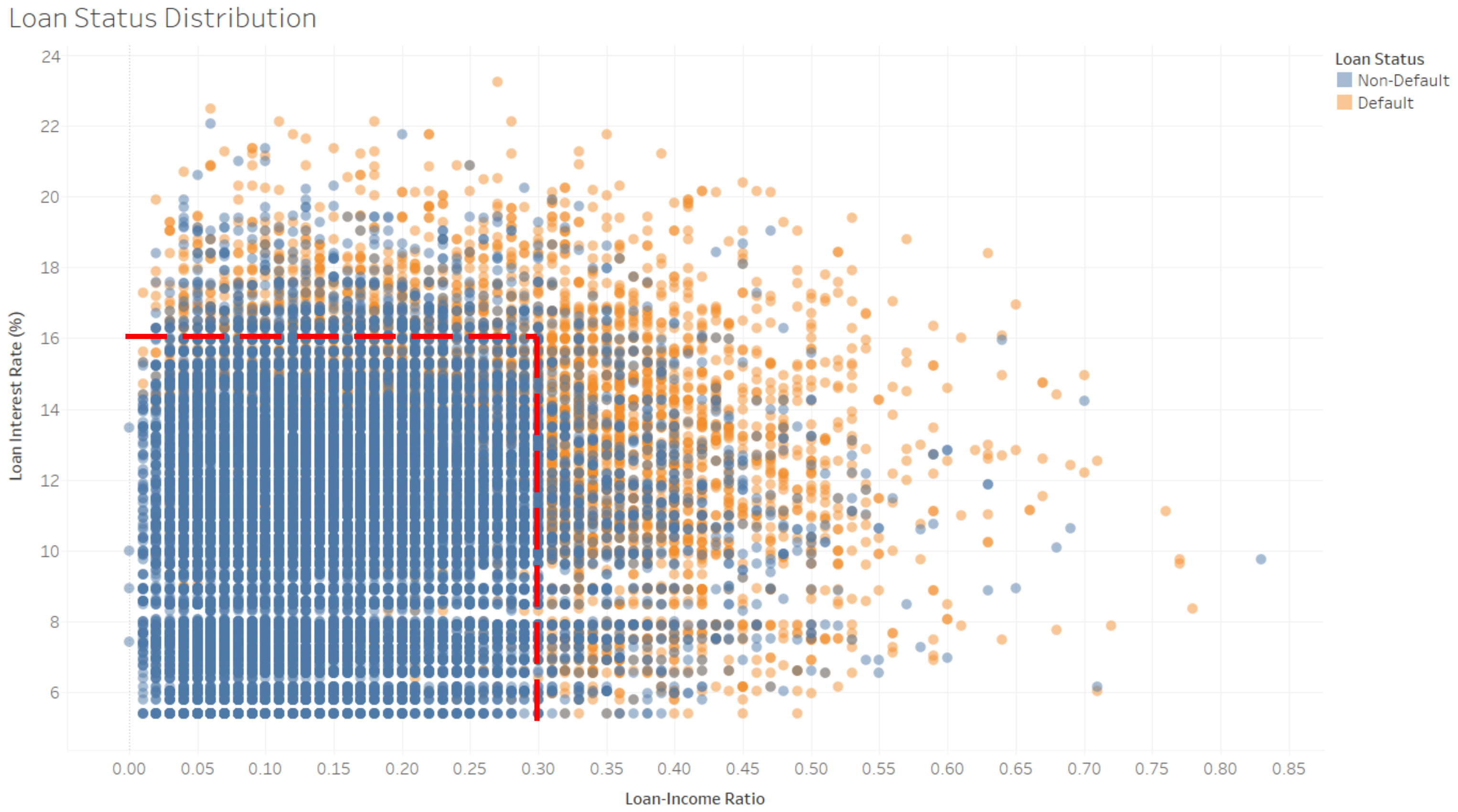
- Loans taken for medical and debt consolidation purposes are likely to default

Exploration of the indicators



- Loan grade ‘D’ is the lowest performing loans with highest number of defaults. Loans with interest rate higher than 14% are graded ‘D to G’ indicating higher risk of defaulting

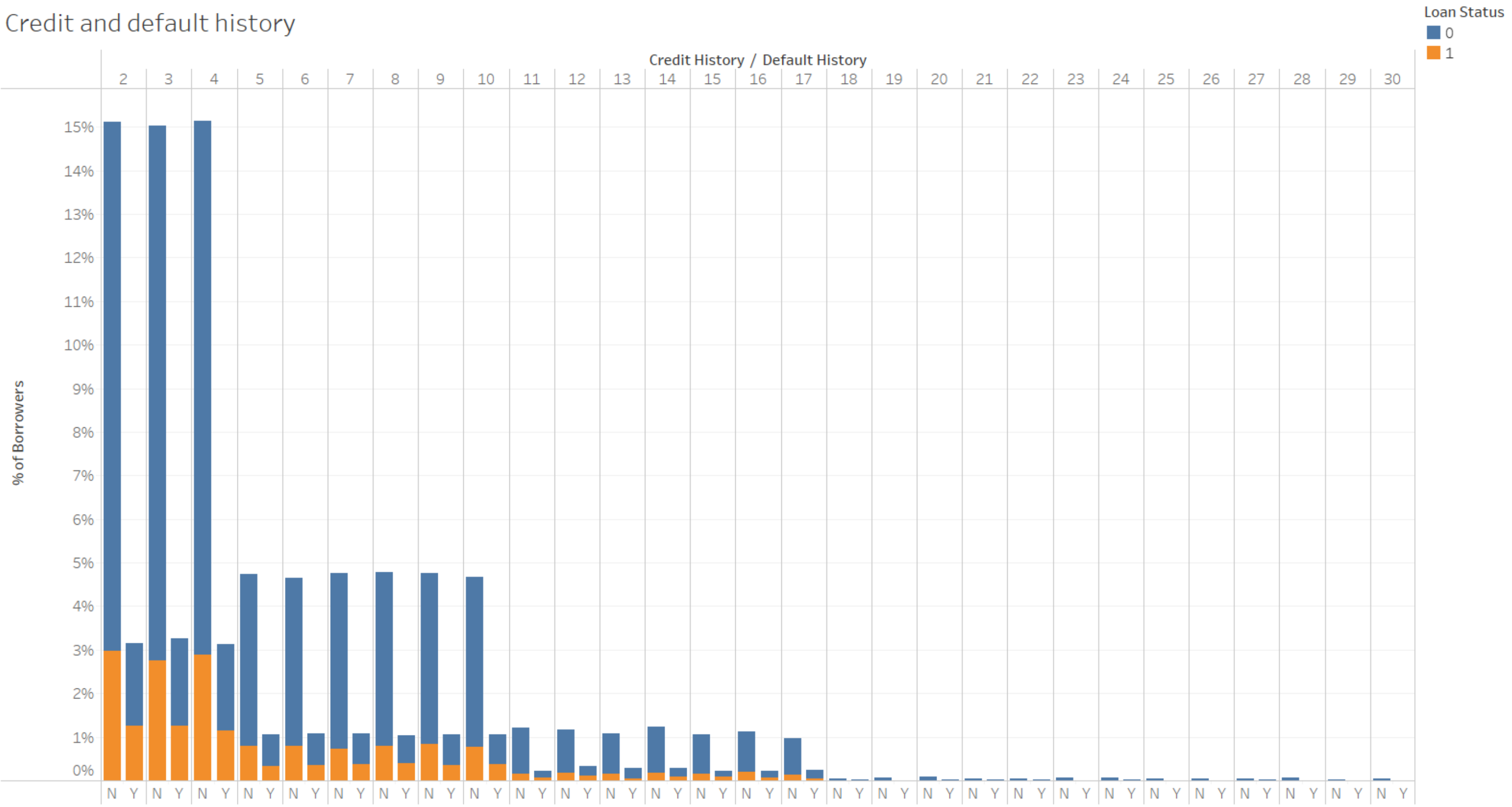
Exploration of the indicators



- Borrowers with loans that have interest rate higher than 16% and loan-income ratio of more than 0.3 are more likely to default

Source: Kaggle and Department of Statistics, Singapore |
Prepared by: Alvin Lie

Exploration of the indicators



- Borrowers with credit history of 2-4 years make up the bulk of the borrowers and show higher percentages of defaulters. History of default does not seem to be a good indicator of defaulting

Source: Kaggle and Department of Statistics, Singapore |
Prepared by: Alvin Lie

Predictive model success metrics

Recall

- Effect of false non-default is costly to the bank because defaulters are classified as non-defaulters

Precision

- Effect of false default is missed business opportunity because non-defaulters are classified as defaulters

Predictive model performance

Confusion Matrix

TARGET : LOAN_STATUS

Observed	Predicted		
	1	0	Percent Correct
1	496	122	80.3%
0	113	2,123	94.9%
Percent Correct	81.4%	94.6%	91.8%

Less correct — More correct

Algorithm	Recall (Optimized)	Accuracy	Average precis...	Balanced Accu...	F_1	Log loss	Precision	ROC AUC
LGBM Classifier	0.803	0.918	0.910	0.876	0.808	0.234	0.814	0.955

- The preliminary predictive model shows promising results with Recall and Precision of at least 80%

High-probability default example

~80% probability to default

Borrower's indicators:

- Age - 40 years old
- Income - $60,000
- Home ownership - OWN
- Employment length - 15 years
- Loan intent - MEDICAL
- Loan amount - $45,000
- Loan interest rate - 20%
- Loan-income ratio - 0.75
- Default history - Yes
- Credit history - 5 Years

Result


```
{
    "predictions": [
        {
            "fields": [
                "prediction",
                "probability"
            ],
            "values": [
                [
                    1,
                    [
                        0.19565150275634302,
                        0.804348497243657
                    ]
                ]
            ]
        }
```

Low-probability default example

~10% probability to default

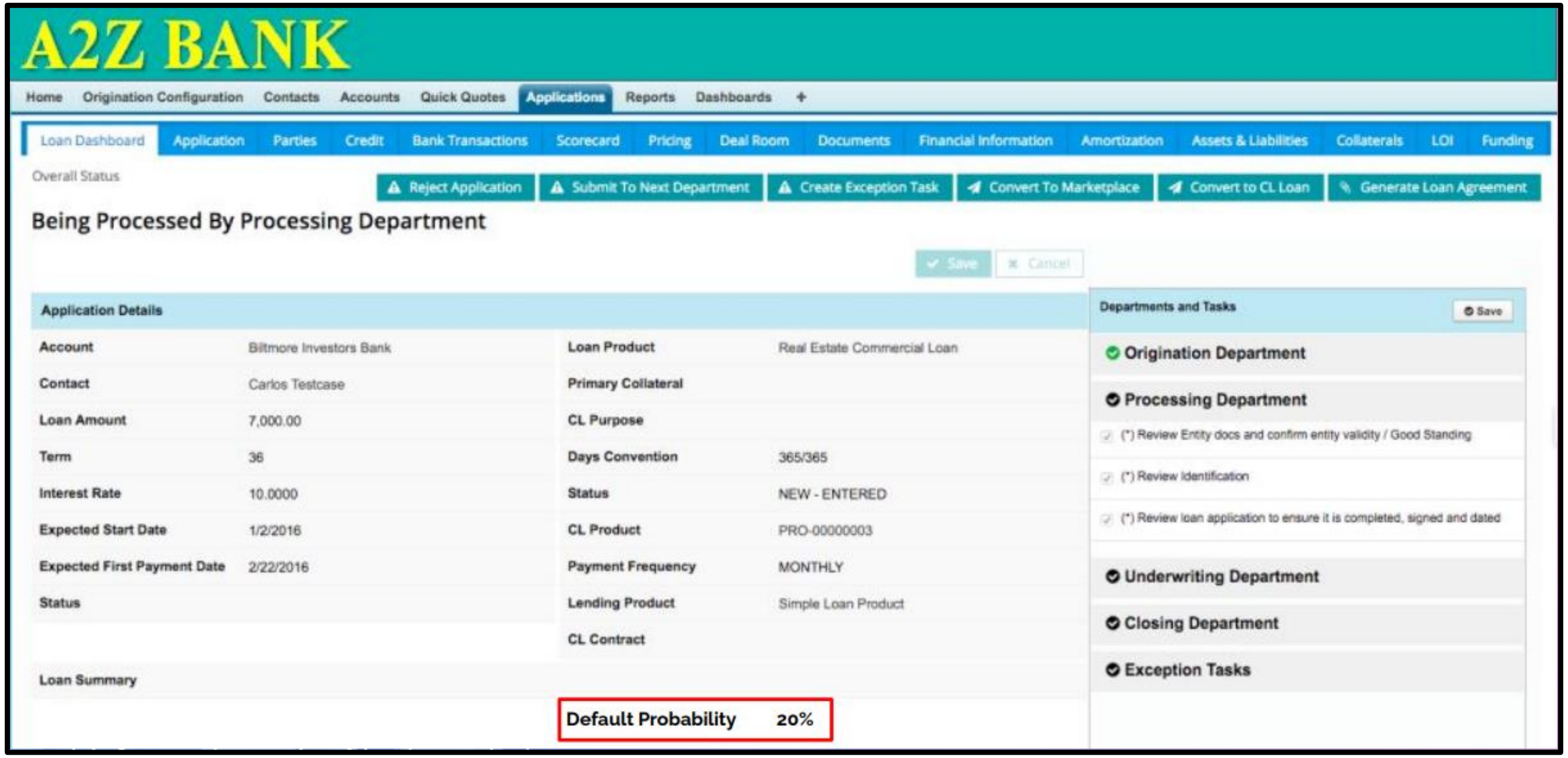
Borrower’s indicators:

- Age - 25 years old
- Income - $40,000
- Home ownership - RENT
- Employment length - 1 year
- Loan intent - EDUCATION
- Loan amount - $10,000
- Loan interest rate - 10%
- Loan-income ratio - 0.25
- Default history - No
- Credit history - 1 year

Result

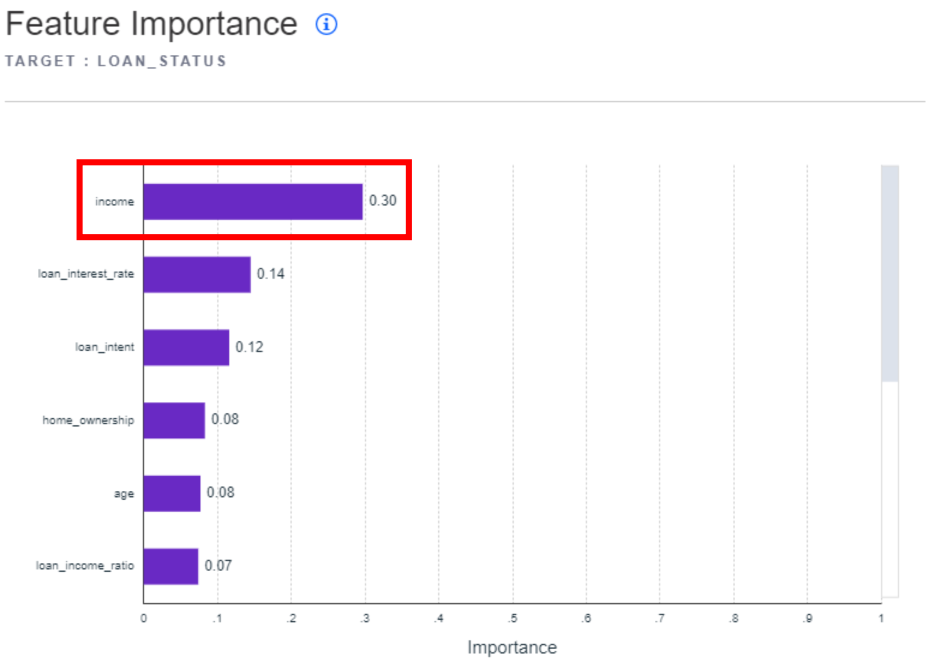

```
{
    "predictions": [
        {
            "fields": [
                "prediction",
                "probability"
            ],
            "values": [
                [
                    0,
                    [
                        0.9030697225889706,
                        0.09693027741102946
                    ]
                ]
            ]
        }
```

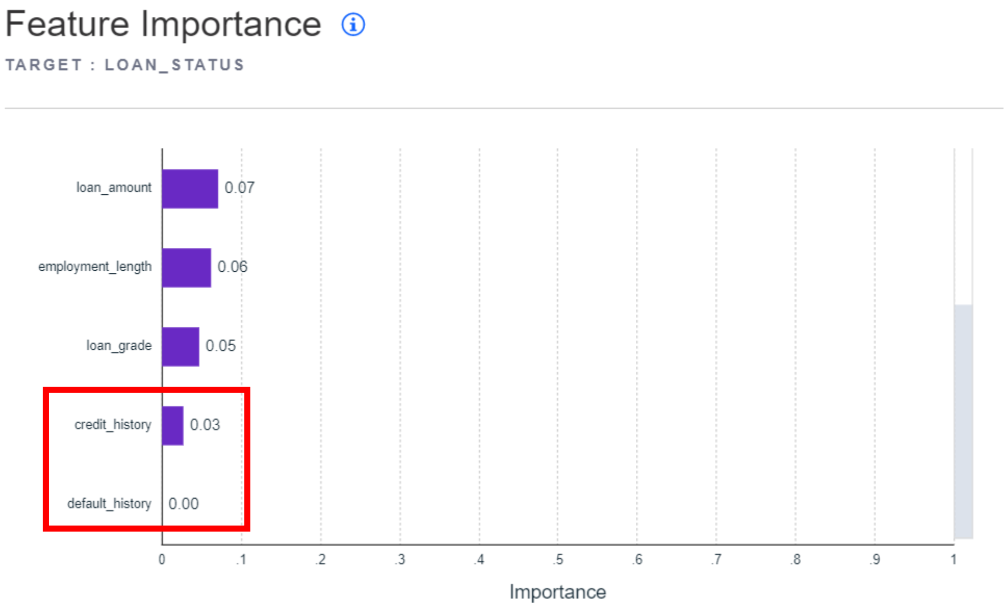
Prototype



A2Z BANK
Home Origination Configuration Contacts Accounts Quick Quotes Applications Reports Dashboards
Loan Dashboard Application Parties Credit Bank Transactions Scorecard Pricing Deal Room Documents Financial Information Amortization Assets & Liabilities Collaterals LOI Funding
Overall Status
Reject Application
Submit To Next Department
Create Exception Task
Convert To Marketplace
Convert to CL Loan
Generate Loan Agreement
Being Processed By Processing Department
Save
Cancel
Application Details
Account Biltmore Investors Bank
Contact Carlos Testcase
Loan Amount 7,000.00
Term 36
Interest Rate 10.0000
Expected Start Date 1/2/2016
Expected First Payment Date 2/22/2016
Status
Loan Product Real Estate Commercial Loan
Primary Collateral
CL Purpose
Days Convention 365/365
Status NEW - ENTERED
CL Product PRO-00000003
Payment Frequency MONTHLY
Lending Product Simple Loan Product
CL Contract
Loan Summary
Default Probability 20%
Departments and Tasks
Save
Origination Department
Processing Department
(*) Review Entity docs and confirm entity validity / Good Standing
(*) Review Identification
(*) Review loan application to ensure it is completed, signed and dated
Underwriting Department
Closing Department
Exception Tasks

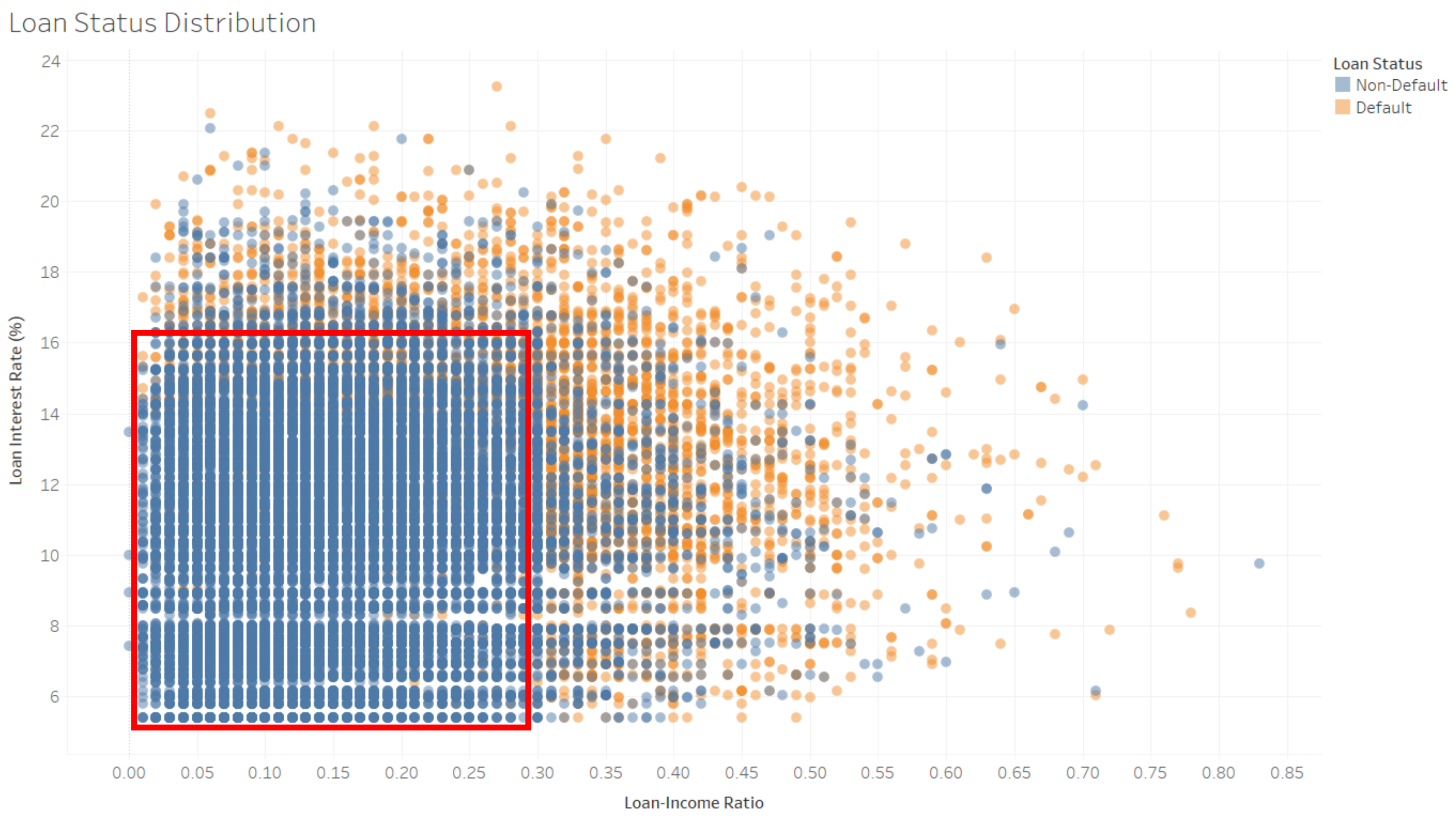
Importance of the indicators





- The applicant's income has the highest importance in predicting the likelihood of a default
- Credit and default history are of low importance in predicting default, thus the predictive model will work just as well for new loan applicants

Recommendation



- To reduce loan defaults it is recommended to limit loan amount up to $35,000, charge loan interest rate of not more than 16% and ensures borrowers' loan-income ratio is less than 30%

Action plan

Create a loan product with amount up to $35,000 and interest rate of not more than 16%

Probability of default generated by the predictive model to aid the credit analysts in their decision when considering loan approval

These actions will achieve the objectives of reducing loan defaults through having more quality borrowers and increasing the approval rate of loans by credit analyst