

Project 1

BC Finance company

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Students:

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Problem Statement:

BC Finance company deals with loans home loans of all urban, semi-urban and rural areas. BC Finance is spending a lot of time on determining if the customers are eligible, to take out a loan. By spending more time on determining if a customer is eligible, can cause loss in money and or customers. The process might take very long and customer would feel that they could find a better solution at another company. Having a large presence creates a big opportunity, but having all these potential customers can cause some of the loans to be allocated incorrectly and cause other legal issues and loss in money.

The company wants to automate the process of identifying whether a customer is eligible for a loan, and they want this done in real time.

The company has provided a partial dataset containing the loan id of individuals, their gender, marital status, education, their number of dependents, the individual's income, the loan amount they are applying for, the individual's credit history and other relevant features. The objective is to use machine learning algorithms to automate the identification of eligible customers based on the information provided.

Hypothesis:

Based on the given data, the machine will most likely allocate loans to citizens that are more developed or successful than those that live in areas that are less developed and economically struggle to get income or have access to education. It is also very unlikely that, but not impossible that an individual that has not taken out a loan before, will be allocated a loan.

1. Income hypothesis

Higher income individuals are more eligible to receive a loan than lower income individuals.

2. Dependents hypothesis

Individuals with less than 3 dependents are more eligible to receive a loan than individuals with 3 or more dependents.

3. Credit history hypothesis

Individuals with a credit history are more likely to be eligible to receive a loan than individuals without a credit history.

4. Loan amount hypothesis

Individuals applying for higher loan amounts are more likely to be eligible to receive the loan than individuals applying for lower loan amounts.

5. Gender hypothesis

Male applicants are more likely to be eligible to receive the loan than female applicants.

6. Education hypothesis

Whether an individual holds a degree or not, will not affect their eligibility for receiving a loan.

7. Marital status

Married applicants are likely to be eligible for a loan than unmarried applicants.

ApplicantIncome and Loan_Amount_Term

1. Prepare data

Import

```
# Imports
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import plotly.express as px
import skimpy as sk

# Avoids displaying warnings
import warnings
warnings.simplefilter('ignore', category=Warning, lineno=0,
append=False)
```

Read the raw_data.csv file

```
# Read file and add the data to the function
df_raw = pd.read_csv('./data/raw_data.csv')
df_raw.head()
```

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	\
0	LP001002	Male	No	0	Graduate	No	
1	LP001003	Male	Yes	1	Graduate	No	
2	LP001005	Male	Yes	0	Graduate	Yes	
3	LP001006	Male	Yes	0	Not Graduate	No	

4	LP001008	Male	No	0	Graduate	No
	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	\	
0	5849	0.0	NaN	360.0		
1	4583	1508.0	128.0	360.0		
2	3000	0.0	66.0	360.0		
3	2583	2358.0	120.0	360.0		
4	6000	0.0	141.0	360.0		
	Credit_History	Property_Area	Loan_Status			
0	1.0	Urban	Y			
1	1.0	Rural	N			
2	1.0	Urban	Y			
3	1.0	Urban	Y			
4	1.0	Urban	Y			

Data Profiling

Using the skim, we can determine a lot about the data that we got from the csv file.

- We have a table with the shape, 614 columns and 13 rows.
- 8 of the columns are type string (Object), 4 are of type float and 1 is an integer type.
- Information like the mean and standard deviation is also displayed.
- The missing values are also displayed

```
sk.skim(df_raw)
```

skimpy summary			
Data Summary		Data Types	
dataframe	Values	Column Type	Count
Number of rows	614	string	8
Number of columns	13	float64	4
		int32	1
			number

column_name				NA	NA %	mean	sd	p0
p25	p50	p75	p100	hist				
2900	3800	5800	81000	0	0	5400	6100	150
0	1200	2300	42000	0	0	1600	2900	0
100	130	170	700	22	3.58	150	86	9
360	360	360	480	14	2.28	340	65	12
1	1	1	1	50	8.14	0.84	0.36	0

string

column_name		NA	NA %	words per row
total words				
1	Loan_ID	614	0	0
0.98	Gender	601	13	2.12
1	Married	611	3	0.49
0.98	Dependents	599	15	2.44
1.2	Education	748	0	0
0.95	Self_Employed	582	32	5.21
1	Property_Area	614	0	0
1	Loan_Status	614	0	0

End

Determining Missing values

The missing values in the table can cause future problems when trying to train a model, so it is important to take care of them.

```
# Display the number of missing values in each column of the dataframe
df_raw.isna().sum()

Loan_ID          0
Gender           13
Married          3
Dependents       15
Education        0
Self_Employed    32
ApplicantIncome  0
CoapplicantIncome 0
LoanAmount       22
Loan_Amount_Term 14
Credit_History   50
Property_Area     0
Loan_Status       0
dtype: int64
```

Handling missing data

Loan_Term_Amount (Hanling missing data)

In the column, there were 14 missing values and we added value to them using the most frequent value. Once new values were added to the column, we plotted the data on a box-and-whisker plot chart.

```
# Replace the missing the data with the mean
mean = df_raw['Loan_Amount_Term'].mean()

# Replace the NaN values with the mean:
df_raw['Loan_Amount_Term'].fillna(mean)

# Indicate change
print("Missing Data:\n", df_raw.isna().sum())

Missing Data:
Loan_ID          0
Gender           13
Married          3
Dependents       15
Education        0
Self_Employed    32
ApplicantIncome  0
CoapplicantIncome 0
LoanAmount       22
```

```
Loan_Amount_Term      14
Credit_History        50
Property_Area          0
Loan_Status            0
dtype: int64
```

Explore

Univariate Analysis

We comparing the amount of individuals that have a loan to those that do not. The information will be displayed using a bar chart.

```
# Display the number of Yes and No of the output feature
if(df_raw['Loan_Status'][0] == 'Y' or df_raw['Loan_Status'][0] ==
'N'):
    df_raw['Loan_Status'] = df_raw['Loan_Status'].map({'Y': 'Yes',
'N': 'No'})

lb_items = df_raw['Loan_Status'].value_counts()

# Univariate
fig = px.bar(
    data_frame=lb_items,
    x=lb_items.index,
    y=lb_items.values,
    title='Loan Status Imbalance',
    color=lb_items.index
)

fig.update_layout(xaxis_title='Status of loan', yaxis_title='Number of
individuals')
fig.show()

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```

Examining the graph we determined that there is a higher number of individuals that have loans, compare to the number of individuals that do not have any loans.

Bivariate Analysis

The following histogram indicates the income of all the individuals in the sample

```
fig = px.histogram(
    data_frame=df_raw,
    x='Loan_ID',
    y='ApplicantIncome',
    title='Income of all the applicants'
)

fig.update_layout(xaxis_title='Applicants', yaxis_title='Income')
```

```
fig.show()
```

```
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Looking at the chart above, there are certain values that are very high compared to others, indicating that there are certain individuals that have a high income. There are also individuals that have a low income. The very high and low values, could effect the training model.

Indication of the Loan_Amount_Term with a histogram

```
fig = px.histogram(
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    x='Loan_ID',
    y='Loan_Amount_Term',
    title='Timeframes given to individuals to pay their loans'
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fig.show()
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```

Looking at the following chart, the data has certain sections. This indicates that the terms of the loans might be in given in similar lengths.

```

# Determening if the Loan_Amount_terms are given in sections
df_raw['Loan_Amount_Term'].value_counts()

```

```

Loan_Amount_Term
360.0    512
180.0     44
480.0     15
300.0     13
240.0      4
84.0       4
120.0      3
60.0       2
36.0       2
12.0       1
Name: count, dtype: int64

```

Looking at the data, it seems that the loan terms are given to the individuals in factors of 12. This could be that the values are in months and that the loans are payable in years. This does not change the data, we still interpret it as numeric data.

Determining and removing outliers.

By making use of box-and-whisker plot charts, we can determine the outliers of the numerical columns.

```
# Determining the outliers

# Plotting numeric features:
fig = px.box(
    data_frame=df_raw['ApplicantIncome'],
    x = df_raw['ApplicantIncome'].values,
    title = f'BoxPlot for Applicant Income'
)

fig.update_layout(xaxis_title='Applicant Income')
fig.show()

# Plotting numeric features:
fig = px.box(
    data_frame=df_raw['Loan_Amount_Term'],
    x = df_raw['Loan_Amount_Term'].values,
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)

fig.update_layout(xaxis_title='Loan Amount Term')
fig.show()

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Looking at the above charts, both of the charts have multiple outliers, that needs to be removed so it does not affect the machine learning model.

Making use of bivariate analysis we can analyse how the outliers are spread between the Loan_Status outcomes

```
# Plotting the data
```

```
fig = px.box(
    data_frame=df_raw['Loan_Amount_Term'],
    x = df_raw['Loan_Amount_Term'].values,
    color = df_raw['Loan_Status'],
    title = f'BoxPlot for Loan Amount Term, where the feature is
against the target'
)
```

```
fig.update_layout(xaxis_title='Loan Amount Term')
fig.show()
```

```
fig = px.box(
    data_frame=df_raw['ApplicantIncome'],
    x = df_raw['ApplicantIncome'].values,
    color = df_raw['Loan_Status'],
    title = f'BoxPlot for Applicant Income, where the feature is
against the target'
)
```

```
fig.update_layout(xaxis_title='Applicant Income')
fig.show()
```

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Looking at the chart it feels that the outliers are evenly spread between the outcomes of the Loan_Status

Taking care of the outliers

ApplicantIncome

```
# Remove outliers of ApplicantIncome
Q1_app = df_raw['ApplicantIncome'].quantile(0.25)
Q3_app = df_raw['ApplicantIncome'].quantile(0.75)
IQR_app = Q3_app - Q1_app

lower_bound_app = Q1_app - 1.5 * IQR_app
upper_bound_app = Q3_app + 1.5 * IQR_app

outlier_mask_app = (df_raw['ApplicantIncome'] >= lower_bound_app) &
(df_raw['ApplicantIncome'] <= upper_bound_app)

df_raw = df_raw[outlier_mask_app]

# The following displays the effects of removing the outliers in the
ApplicantIncome Column
fig = px.histogram(
    data_frame=df_raw,
    x='Loan_ID',
    y='ApplicantIncome',
    title='Income of all the applicants'
)

fig.update_layout(xaxis_title='Applicants', yaxis_title='Income')
fig.show()

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After the outliers in the ApplicantIncome column was removed, looking at the chart the values of the data is much closer than it originally was.

```
# Removing the outliers in the Loan_Amount_Term
Q1_term = df_raw['Loan_Amount_Term'].quantile(0.25)
Q3_term = df_raw['Loan_Amount_Term'].quantile(0.75)
IQR_term = Q3_term - Q1_term

lower_bound_term = Q1_term - 1.5 * IQR_term
upper_bound_term = Q3_term + 1.5 * IQR_term

outlier_mask_term = (df_raw['Loan_Amount_Term'] >= lower_bound_term) &
(df_raw['Loan_Amount_Term'] <= upper_bound_term)

df_raw = df_raw[outlier_mask_term]

# The following displays the effects of removing the outliers in the
Loan_Amount_Term Column
fig = px.histogram(
    data_frame=df_raw,
    x='Loan_ID',
    y='Loan_Amount_Term',
    title='Timeframes given to individuals to pay their loans'
)

fig.update_layout(xaxis_title='Loan term in months',
yaxis_title='Number of individuals')
fig.show()

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Looking at the chart it seems that all the other values in the column were removed and just the individuals with a Loan_Amount_Term of 360 are left we can confirm this by looking if there are any other values left.

```
df_raw['Loan_Amount_Term'].value_counts()
```

```
Loan_Amount_Term
360.0      469
Name: count, dtype: int64
```

The result above confirms that 360 is the only value in the Loan_Amount_Term left.