Capstone Project-3
Credit Card Default Prediction

Team Members

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Let's Predict!

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Overview & Objective

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Overview

Credit card is a commonly used transaction method in modern society and one of the main business of banks. For banks, it helps the bank to generate interest revenue but at the same time, it raise the liquidity risk and credit risk to the bank.

Objective

This Project is aimed at predicting the case of customers default payments in Taiwan. From the perspective of risk management , the result of predictive accuracy of the estimated probability of default will be more valuable than the binary result of classification – credible or not credible clients.

Data Pipeline

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Data Preprocessing:- At this stage,
- We check for duplicate values and missing values and treat them if any.
- Detecting the outliers and removed it.
- We check the datatype of the features present in our dataset transform them if necessary.

Exploratory Data Analysis (EDA):- At this stage, we conduct an EDA on the selected features in order to better understand their spread , pattern and relationship with the other features. It gives us an intuition as to what is going on in the dataset.

Handling Imbalance Dataset:- We have used SMOTE (**Synthetic Minority Oversampling Technique**) technique which can handle imbalance dataset.

Model Building:- At this stage, we apply various models to understand which one will give us the best result.

Data Summary

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We have credit card default prediction dataset. It has following features (Columns):

1 **ID:-** Denotes a special unique number for clients in our dataset.
2 **LIMIT_BAL:-** It includes both the individual consumer credit and his/her family credit.
3 **GENDER:-** Includes 1 for Male And 2 for Female.
4 **EDUCATION:-** Includes graduate school , university , high school and others clients in our dataset.
5 **MARRIAGE:-** Includes Married , Single and others clients in our dataset.
6 **PAY_0 – PAY_6 :-** Represents the history of past payments.
7 **BILL_AMT1-BILL_AMT6:-** Represents the amount of bill statements from September 2005 to April 2005.
8 **PAY_AMT1-PAY_AMT6:-** Represents the amount of previous payments like amount paid in September 2005 to April 2005.

Note: 'default payment next month' will be our Dependent variable & Others will be Independent variable.
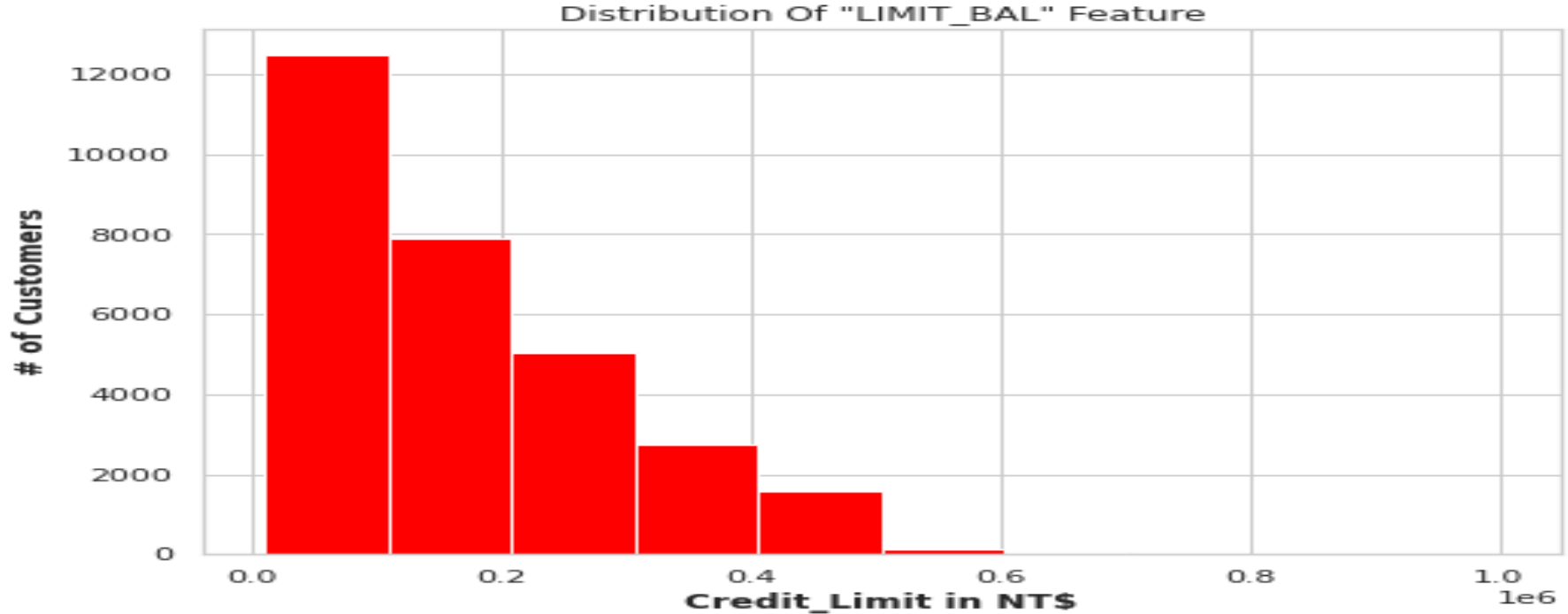
Box plot for whole dataframe to detect outliers
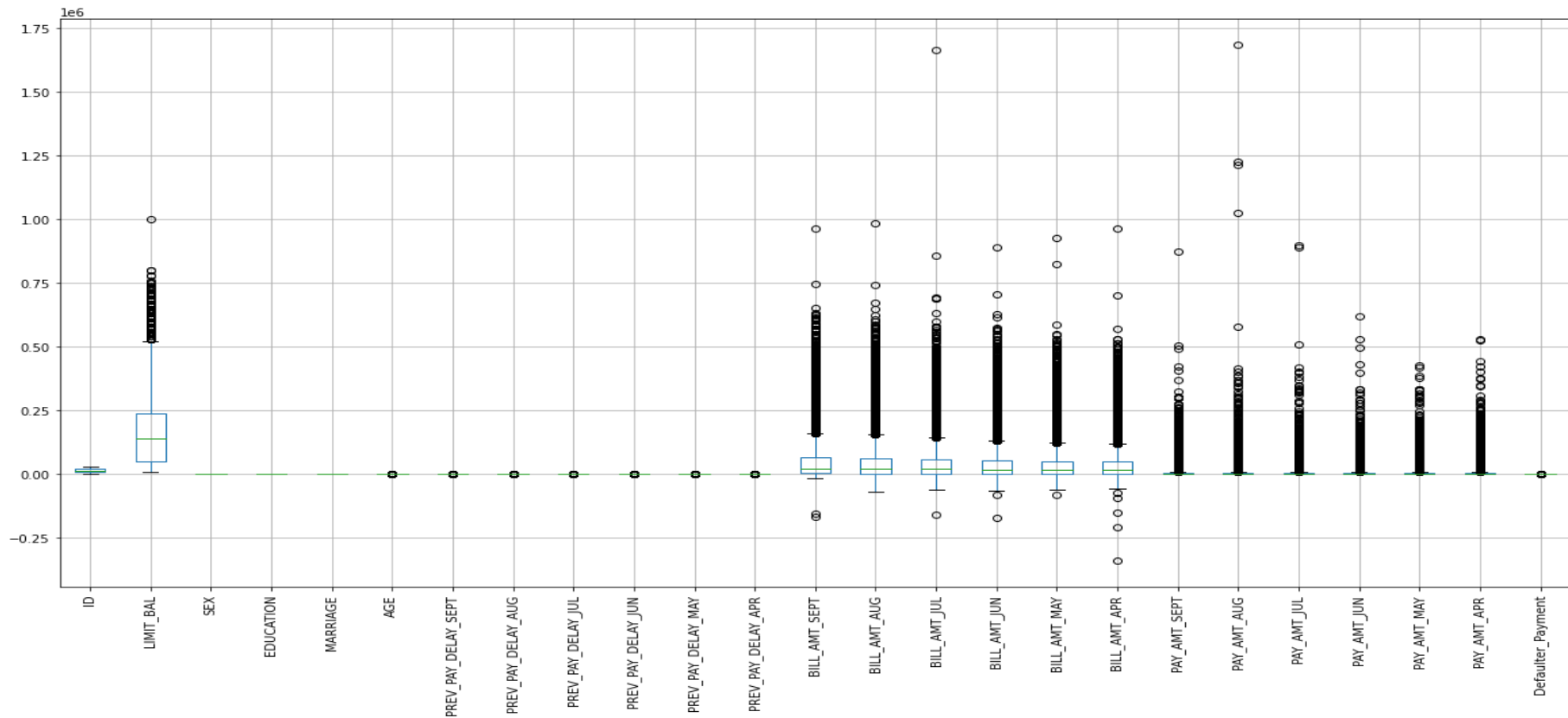
Box plot after removing outliers from the dataset

Distribution Of 'LIMIT_BAL'Feature

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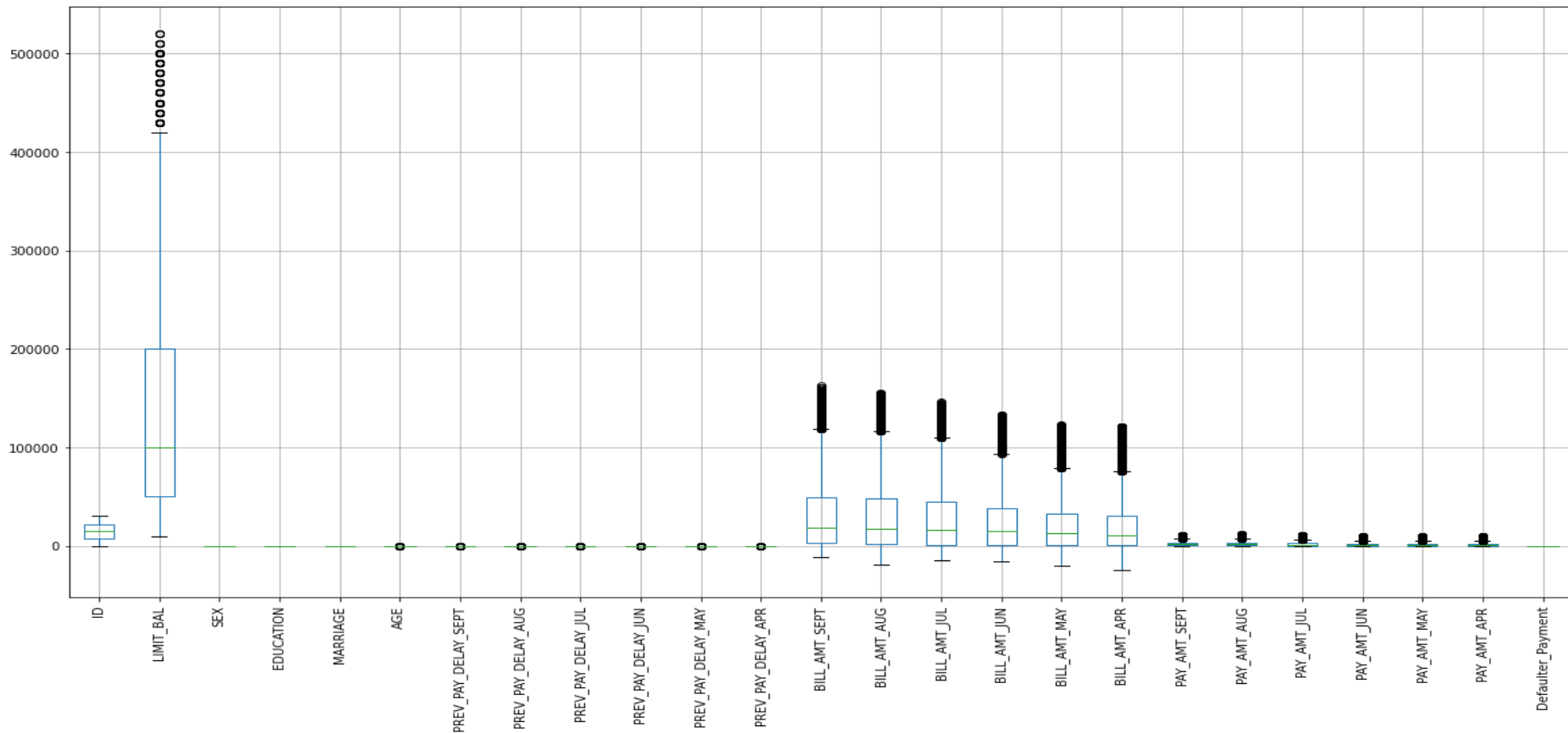
Distribution Of "LIMIT_BAL" Feature

- We can see that the above distribution is a positively skewed distribution i.e. mean != median.
- We can also say that in 0.1 to 1.1 range there are more customers and as the credit limit increases the number of customers tends to decrease.
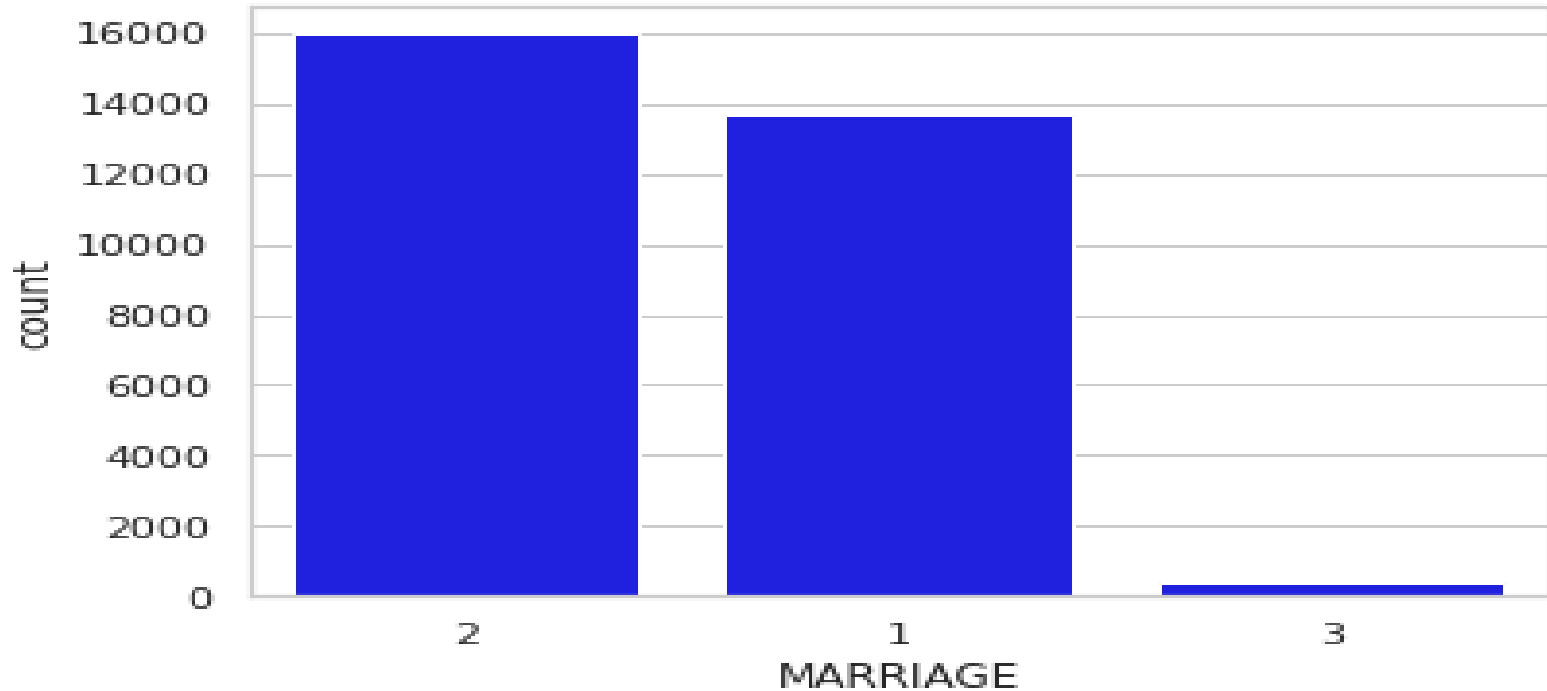
EDA(Exploratory Data Analysis)

The graph conclude that :

- Number of female defaulters are more than male defaulters

- Around 9015 are male non-defaulters and 14349 are female non-defaulters

- Male defaulters are less

Distribution of Male vs Female Defaulters
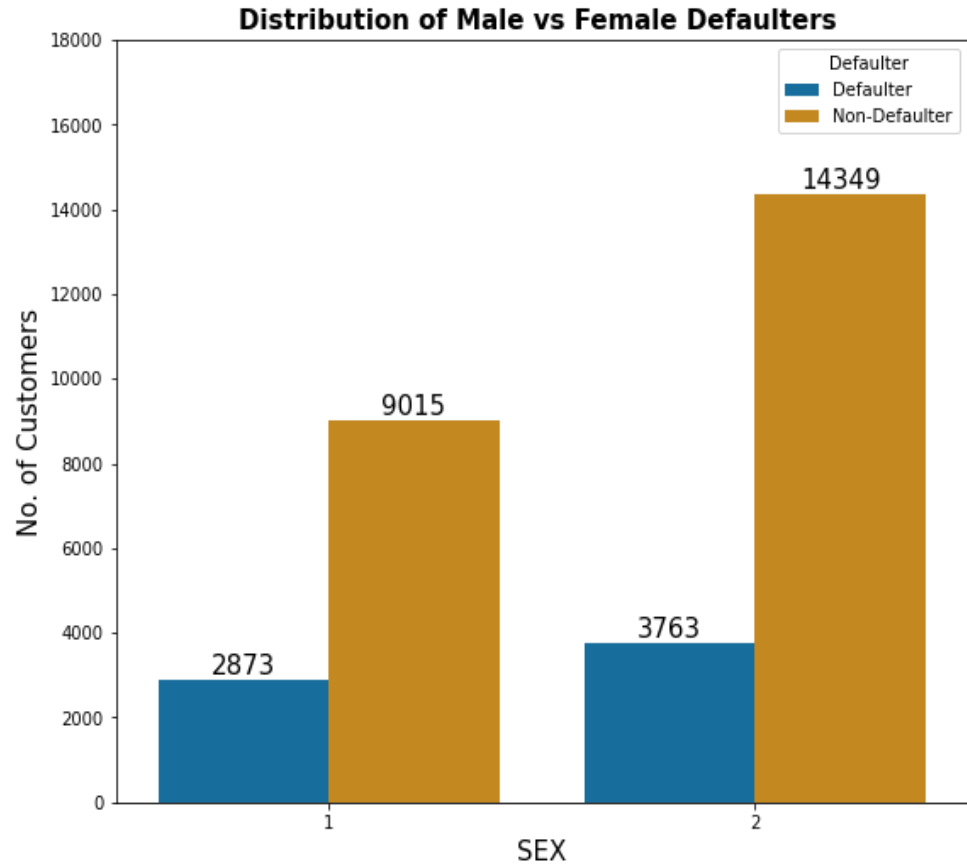
Countplot For The Feature 'MARRIAGE'

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- We can easily say that there are more number of single customers as compared to married customers in our dataset.
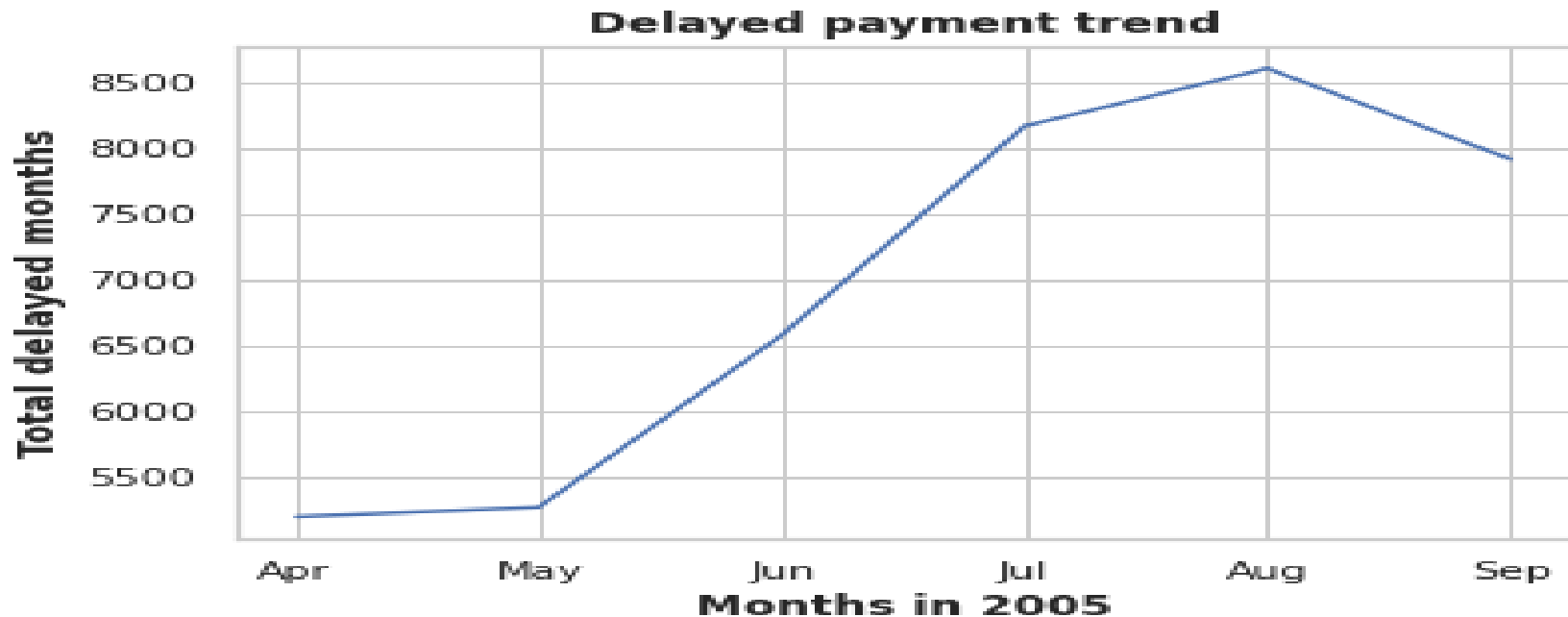
Defaulters acc. to marital status

From the graph we conclude that:

- "1" represent "Married"
- "2" represent "Single"
- "3" represent "Others"
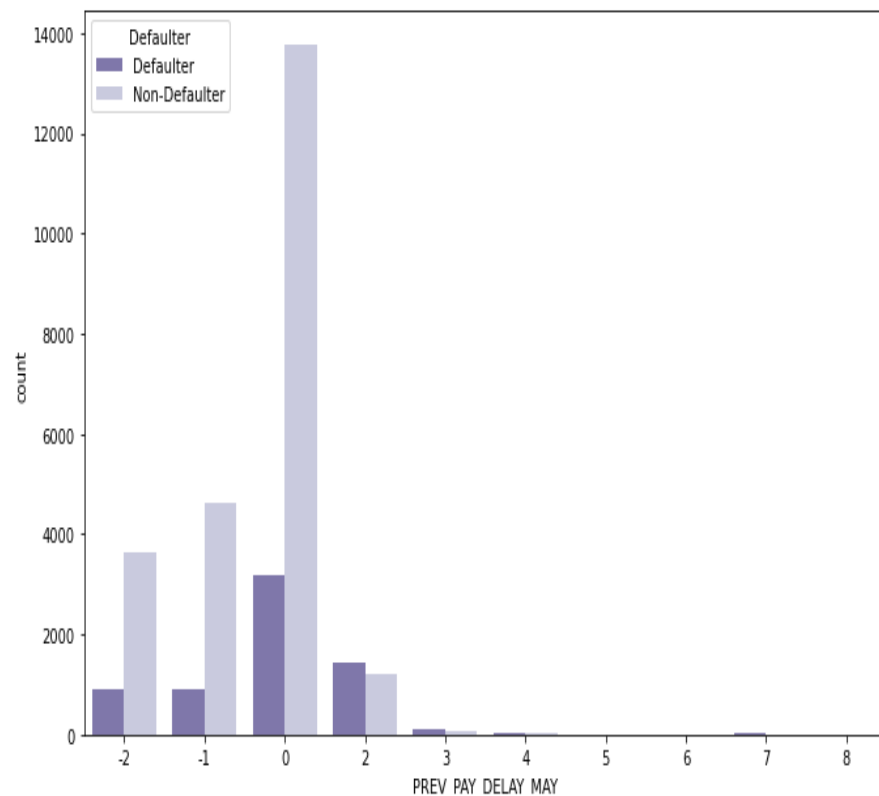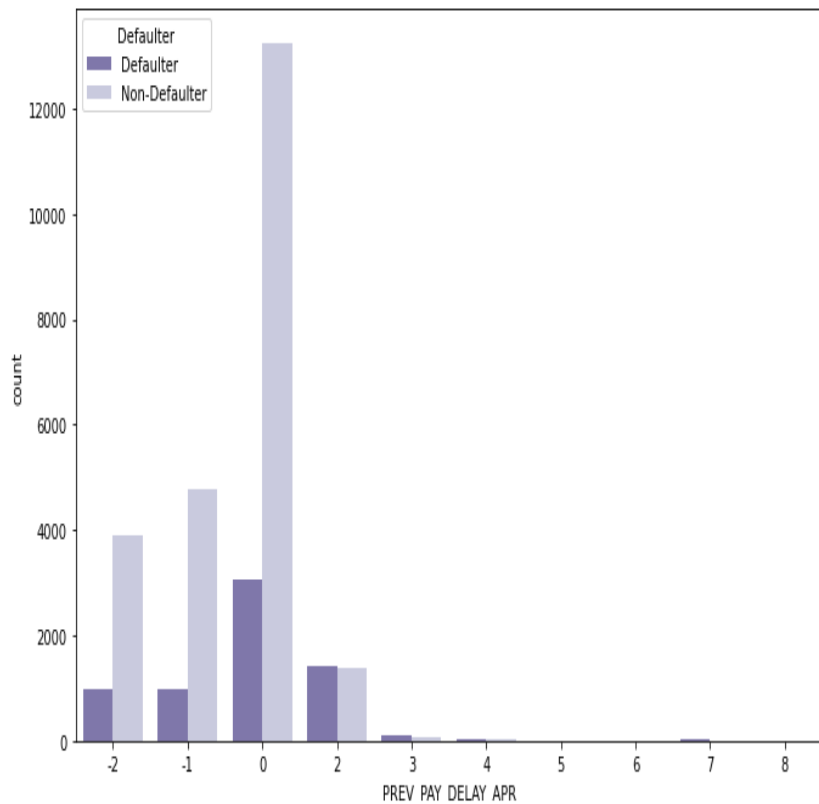- Most of the defaulters and non-defaulters customers are "Single"

Distribution of defaulters acc. to marital status
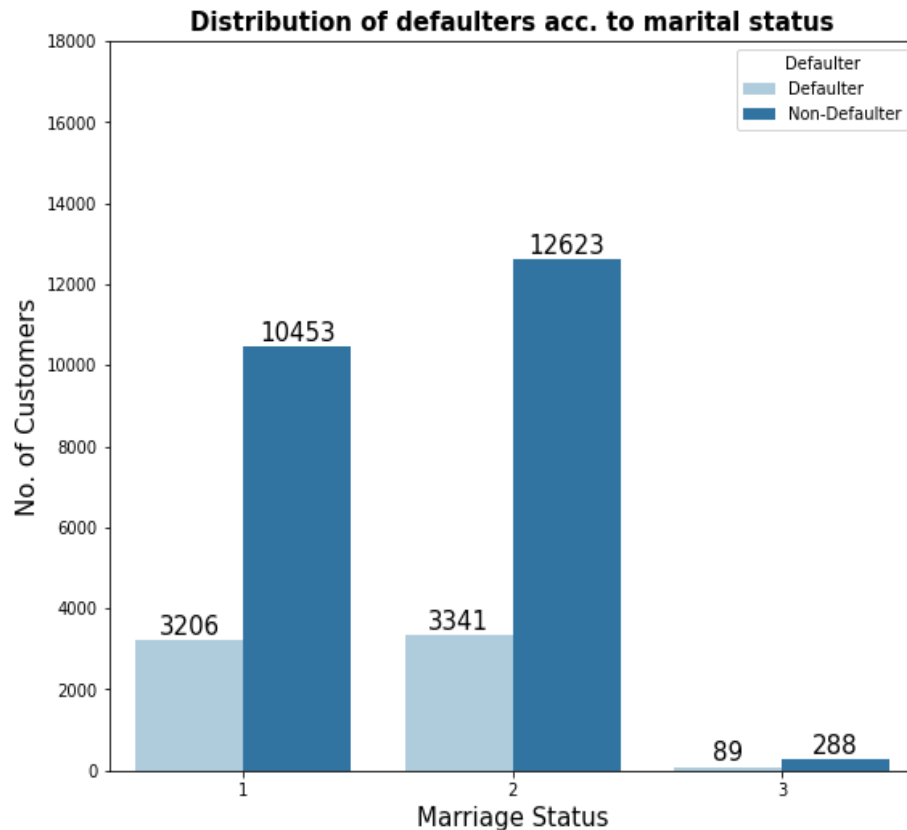
Line Chart To Show The Trend From April 2005 to September   2005


Delayed payment trend

- There was a huge jump from May 2005 (PAY_5) to July 2005 (PAY_3) when delayed payment increased significantly, then it peaked at August 2005 (PAY_2) , After August 2005 (PAY_2) it tends to lost its peakness in September 2005 (PAY_1).
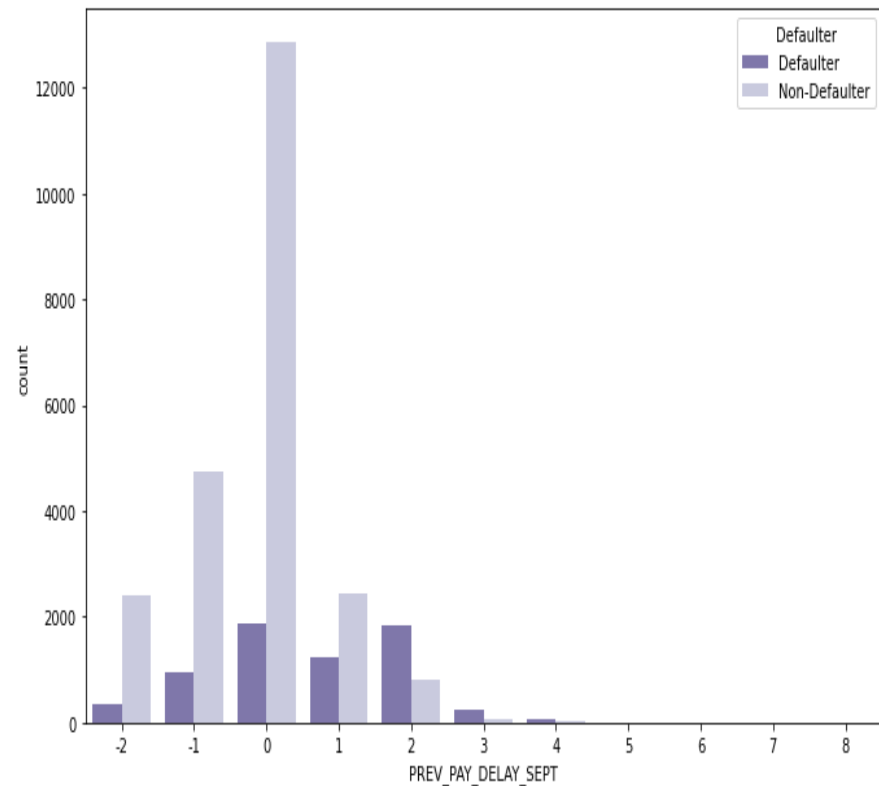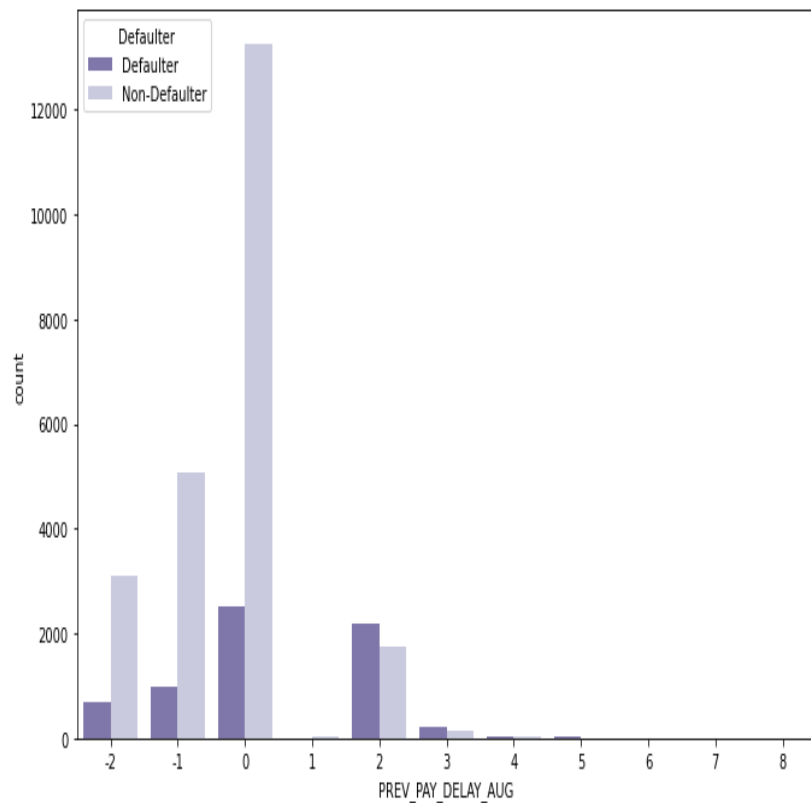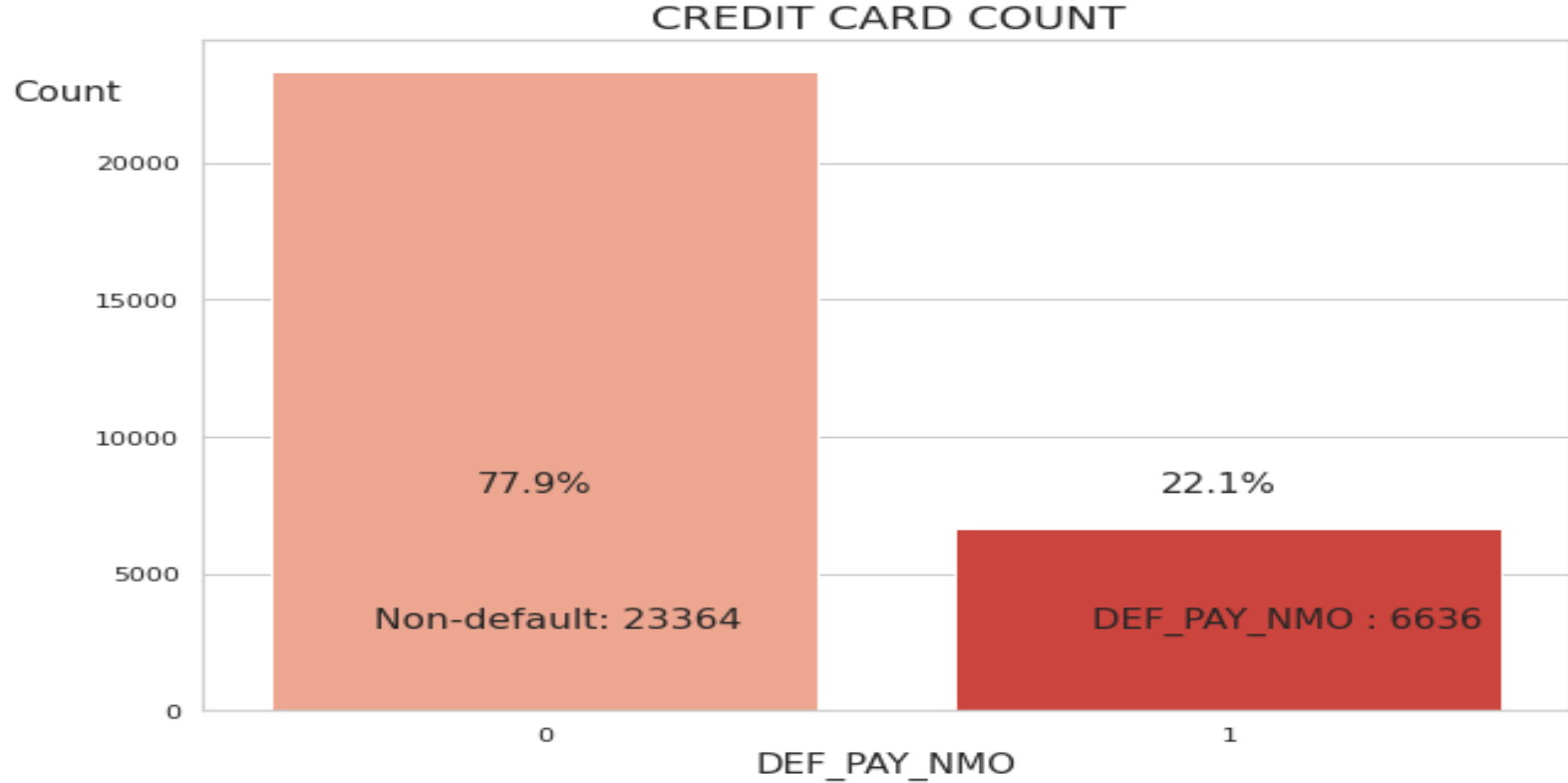
Total no. of months the defaulters have delayed their payment in the previous months

Total no. of months the defaulters have delayed their payment in the previous months
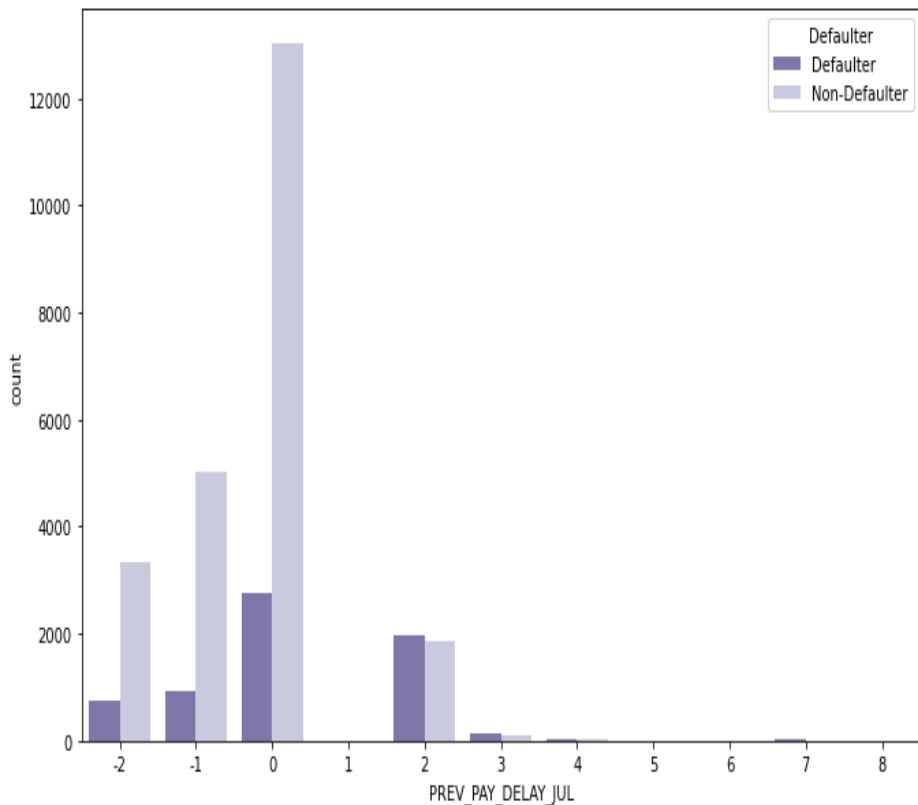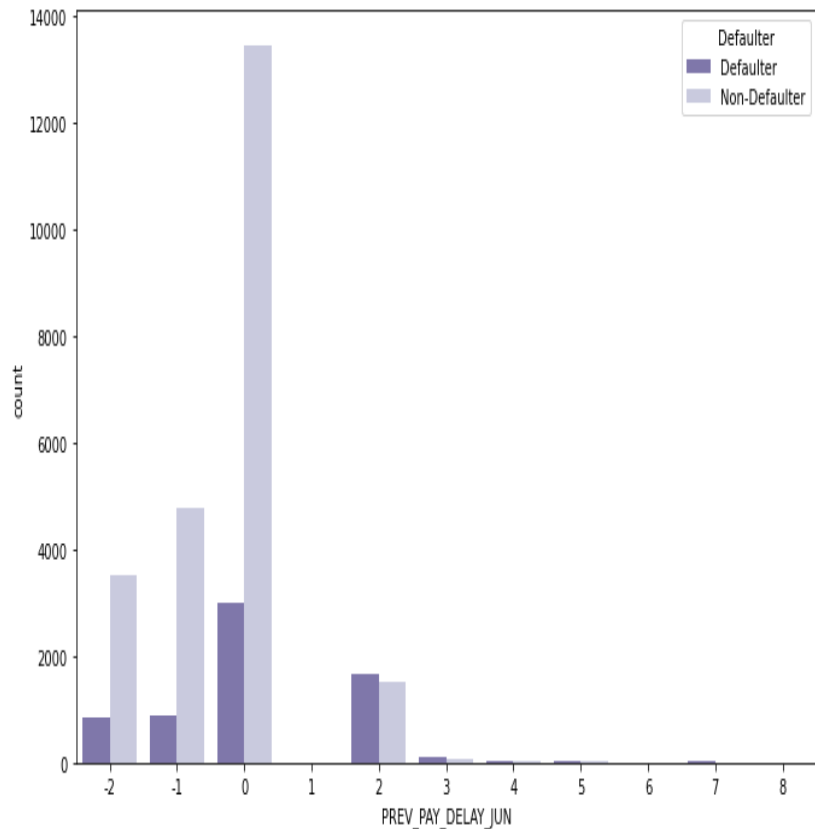
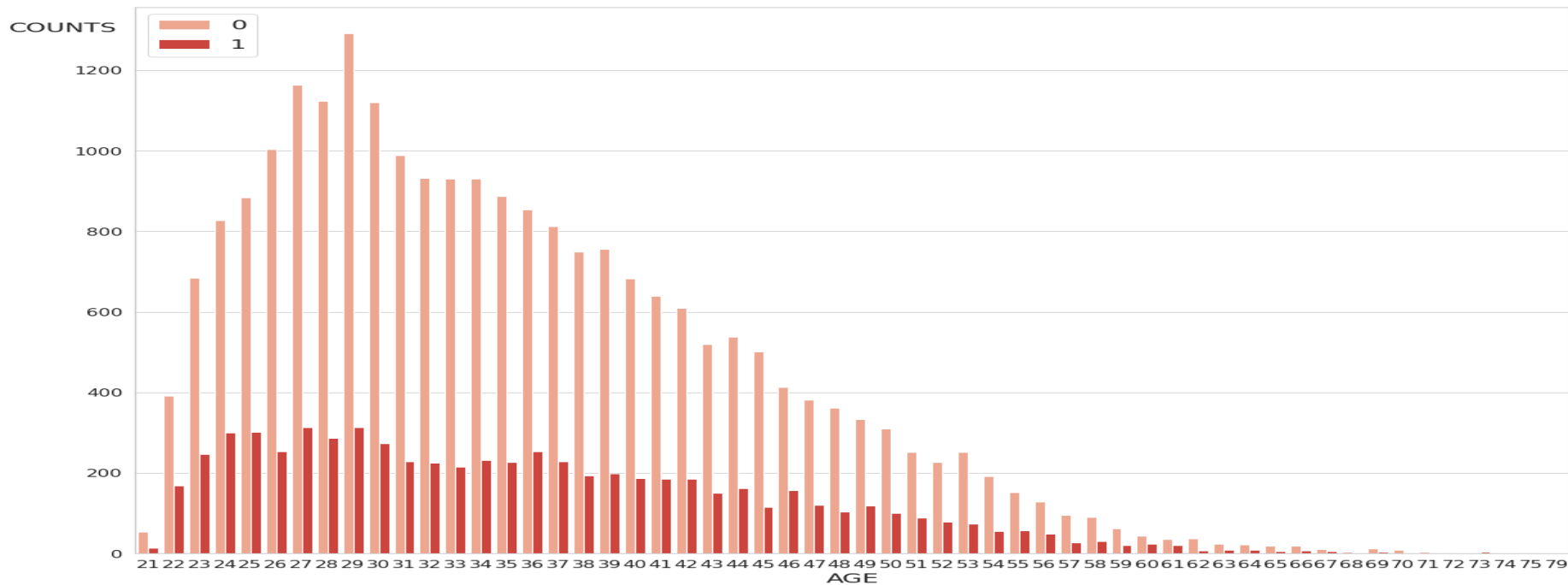# Total no. of months the defaulters have delayed their payment in the previous months

Frequency of Defaulters and Non-Defaulters

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CREDIT CARD COUNT

- From the above count plot , we can see that there are more number of Non-Defaulters compared to Defaulters in our dataset.

Count plot for The Numerical Feature 'AGE'

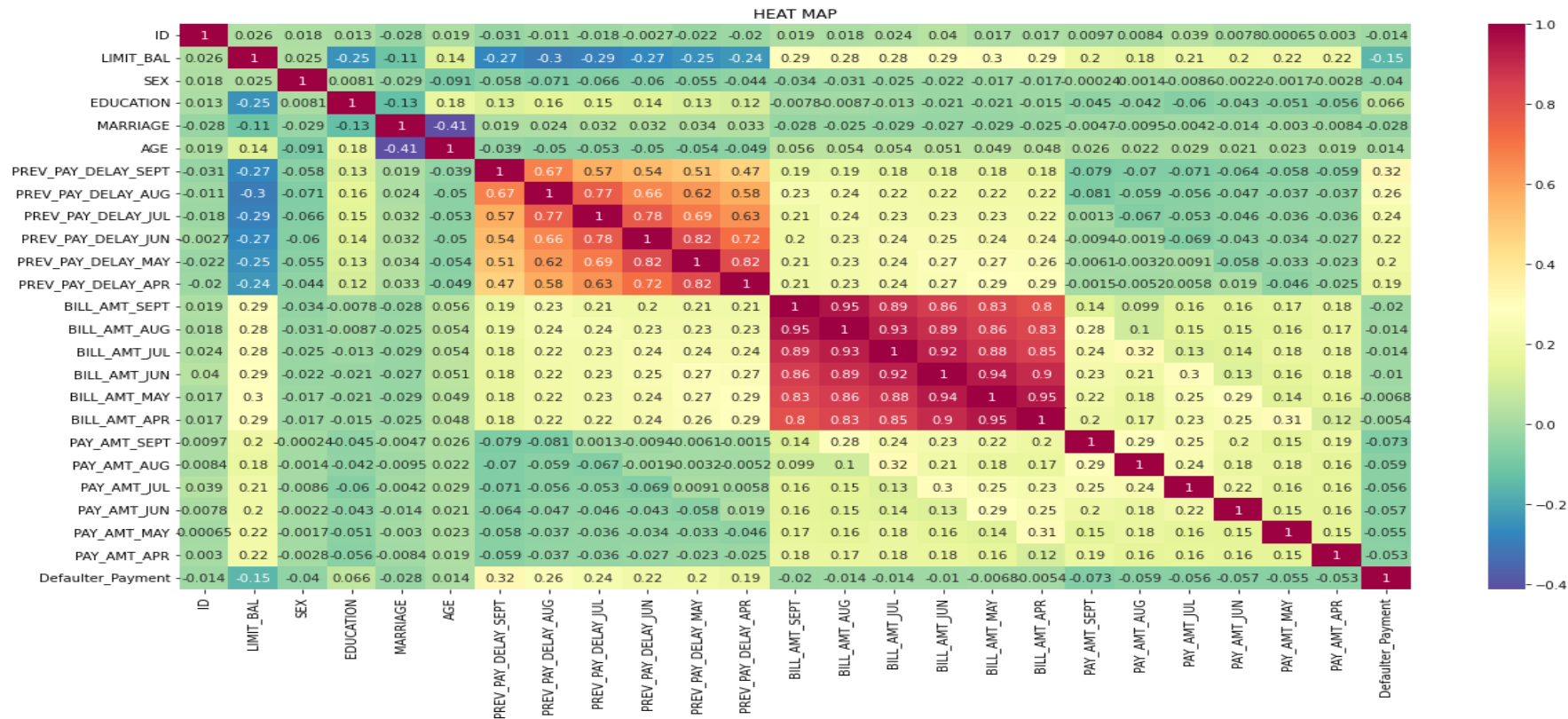- More no. of credit card holders are age between 26-32 years
- 29 years is the highest age for credit card holder
- Age above 60 years are old customers who rarely uses the credit card.
- Also, more number of Defaulters are between 27-29 years.

Plot a continuous variable
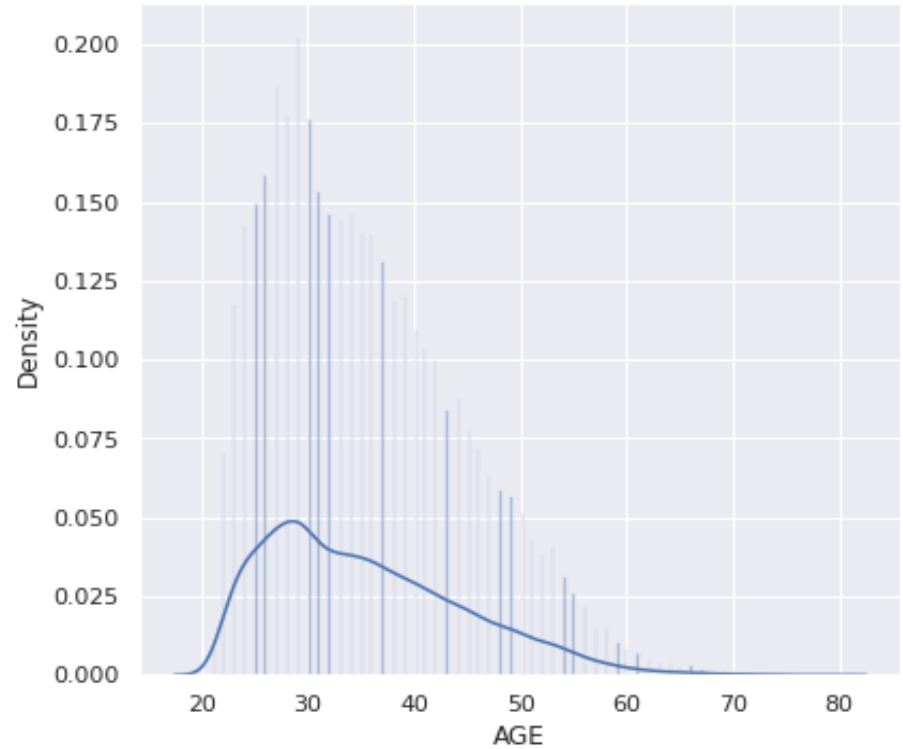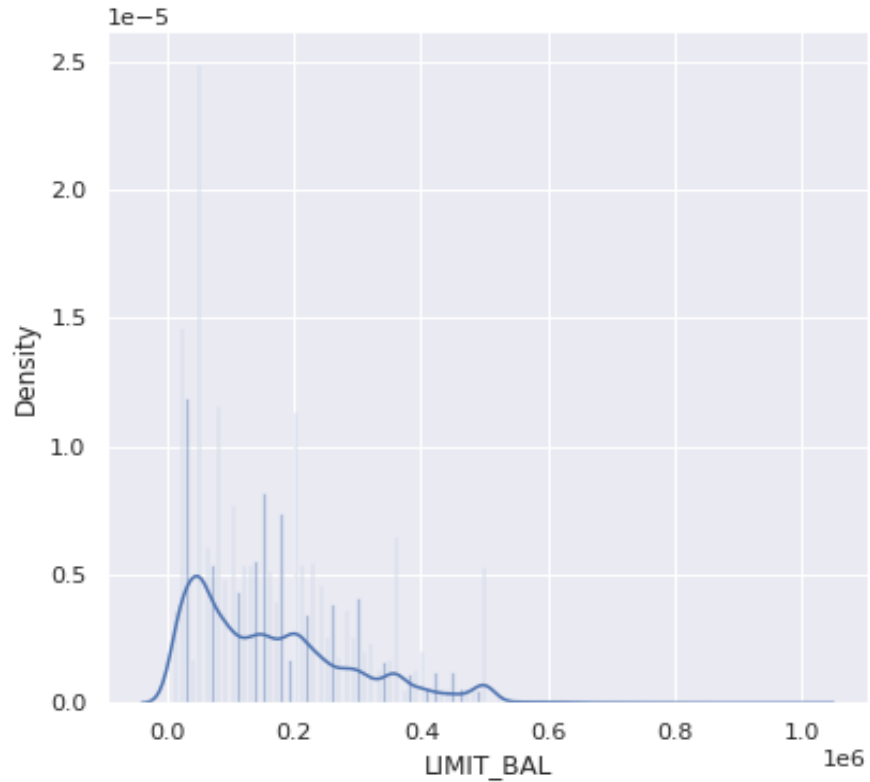
Correlation Between The Variables

HEAT MAP

- We can see that "AGE" and "MARRIAGE" column are negatively correlated with each other.
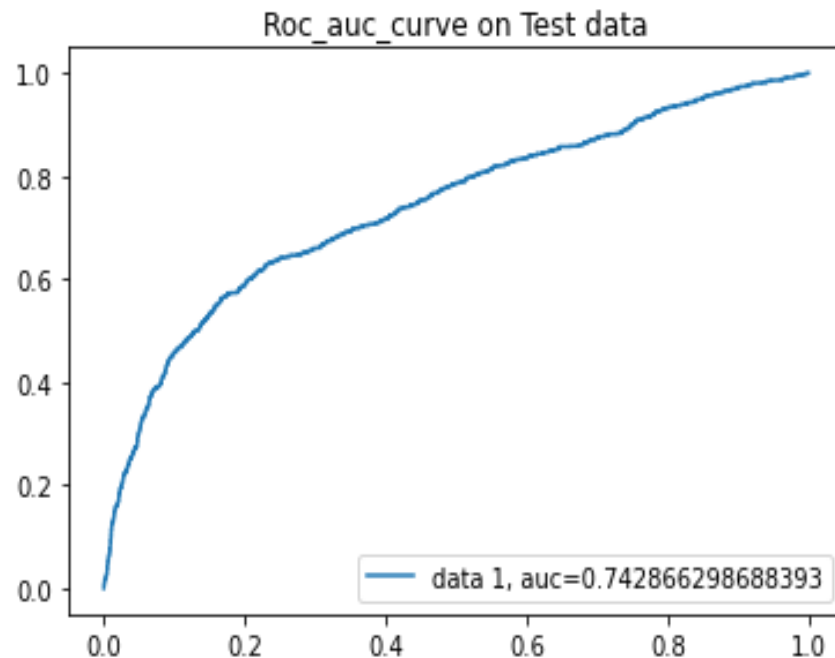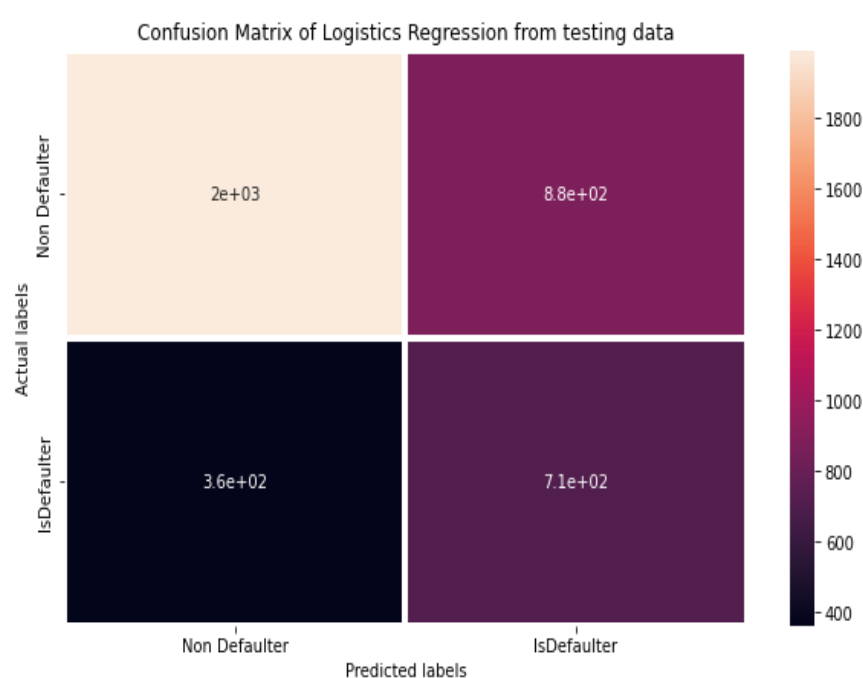
Model Selection

We passed the data into different models like:-

- Logistic Regression
- Random Forest Classifier
- Support Vector Classifier
- K-Neighbor Classifier
- XG Boosting
- Decision Tree Classifier

 We checked the performance of the each model across various parameters:-

- **Accuracy Score:-** finding the difference between actual and predicted value.
- **Precision:-** is a good metric to use when the costs of false positive(FP) is high.
- **Recall:-** is a good metric to use when the cost associated with false negative(FN) is high.
- **F1-Score:-** is a weighted average of precision and recall.
- **ROC-AUC**
- o **ROC curve (Receiver Operating Characteristic Curve):-**
   is a graph showing the performance of a classification model at all classification thresholds.
- o **AUC stands for "Area under the ROC Curve."** That is, AUC measures the entire two-dimensional area underneath the entire ROC curve

Logistic Regression

Confusion Matrix of Logistics Regression from testing data

	Non Defaulter	IsDefaulter
Non Defaulter	2e+03	8.8e+02
IsDefaulter	3.6e+02	7.1e+02

Roc_auc_curve on Test data
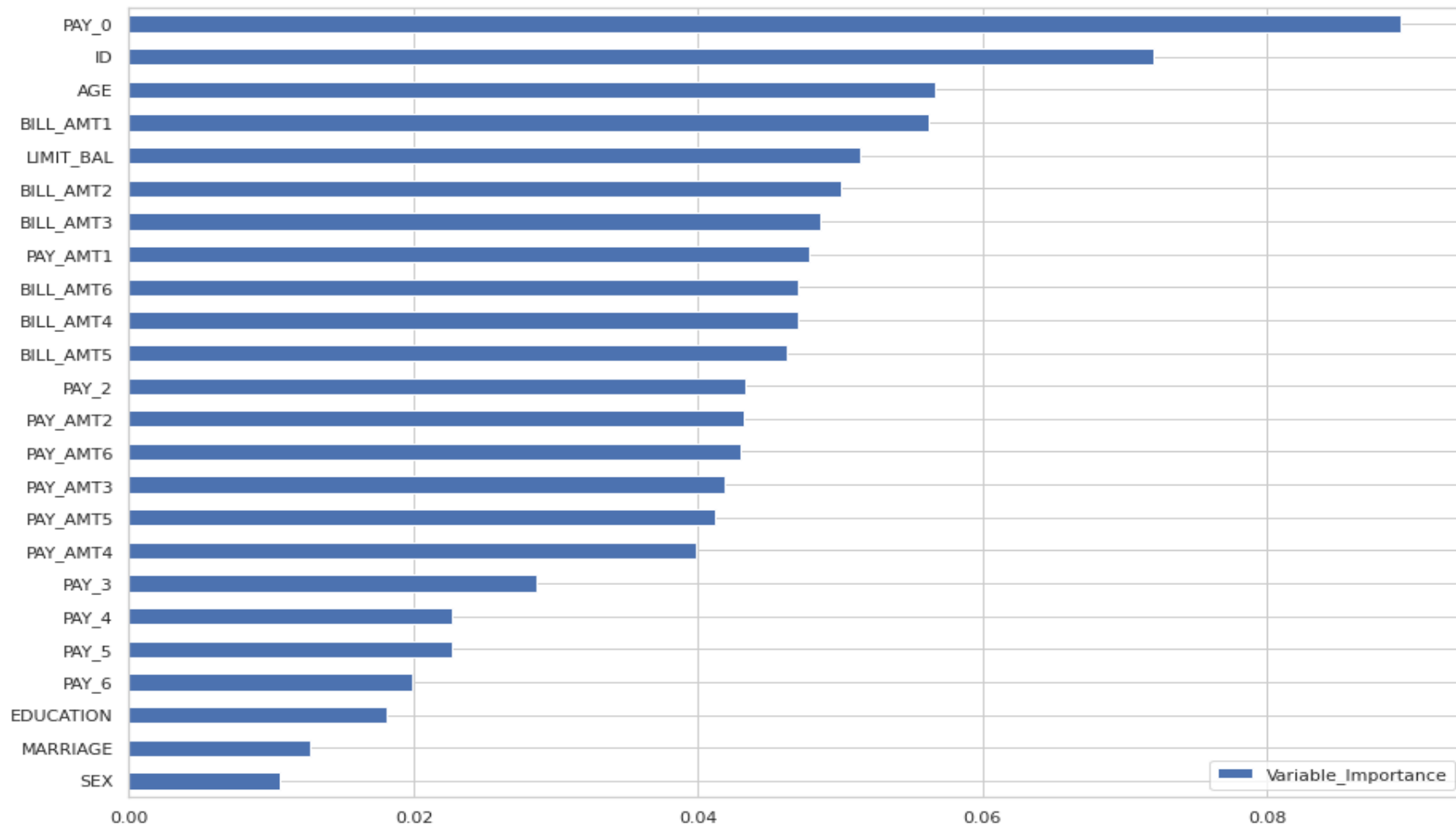
data 1, auc=0.742866298688393

- We have implemented logistic regression and we are getting accuracy score is approx 69%
- Precision score approx is 45% and F1_score is 54%
- roc_auc approx is 68% and recall score is approx 67%
- Here, 1 denote the class for defaulters in AUC curve having value of 0.742

Random Forest Classifier

Confusion Matrix of Random Forest from testing data
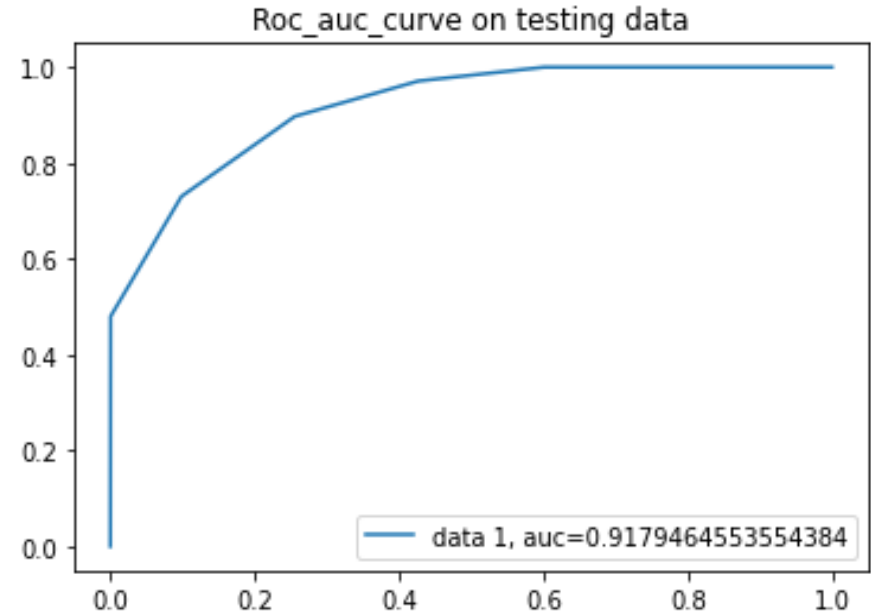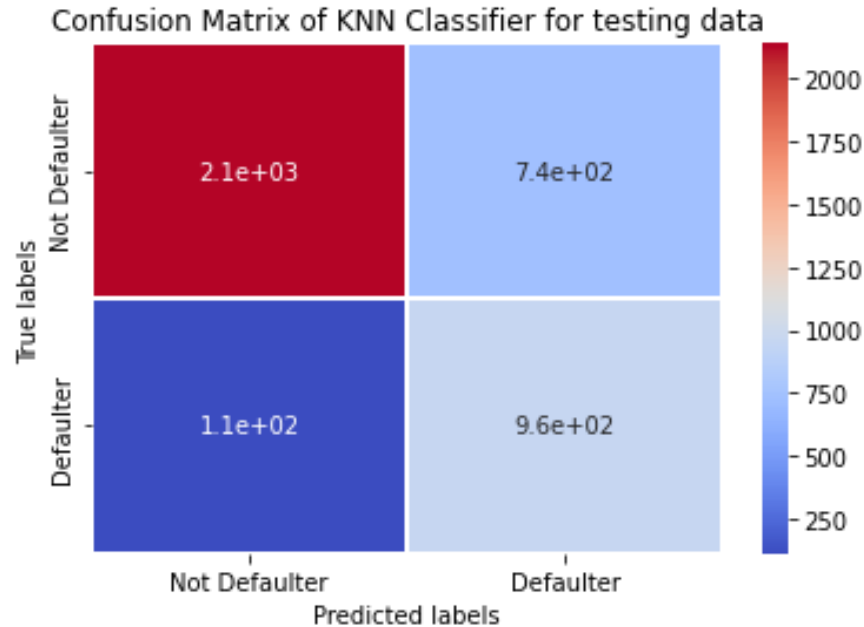

Roc_auc_curve on Test data
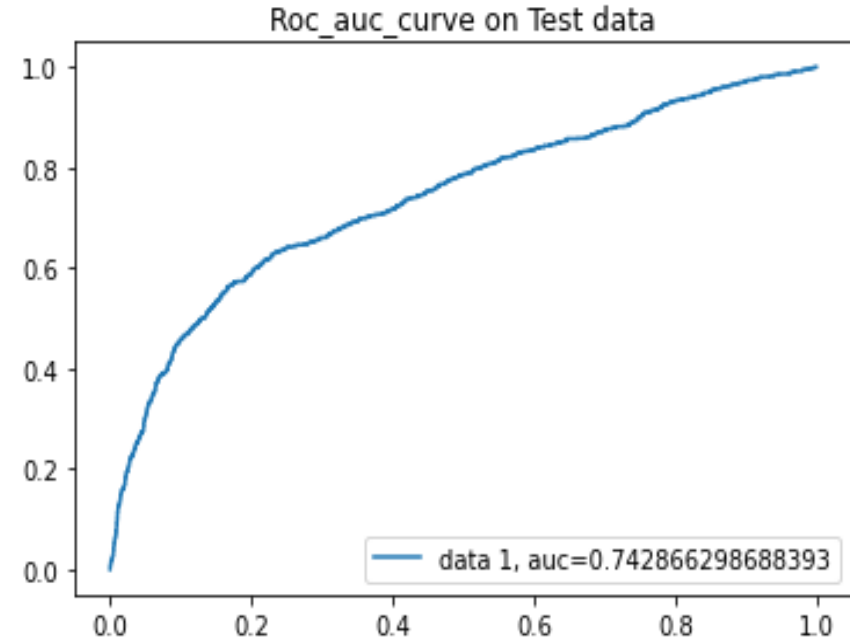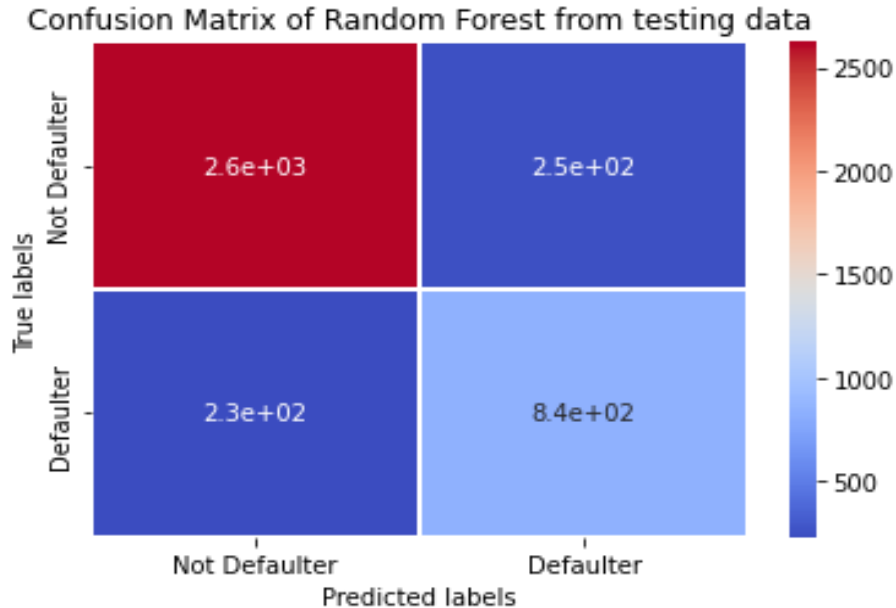
- We have implemented random forest and we are getting accuracy score is approx 88%.
- Precision score approx is 78% and F1_score is 78.44%
- roc_auc approx is 85.40% and recall score is approx 79.36%
- Here, 1 denote the class for defaulters in AUC curve having value of 0.742

Feature Selection Described By Random Forest

K-Neighbor Classifier

Confusion Matrix of KNN Classifier for testing data

Roc_auc_curve on testing data

data 1, auc=0.9179464553554384
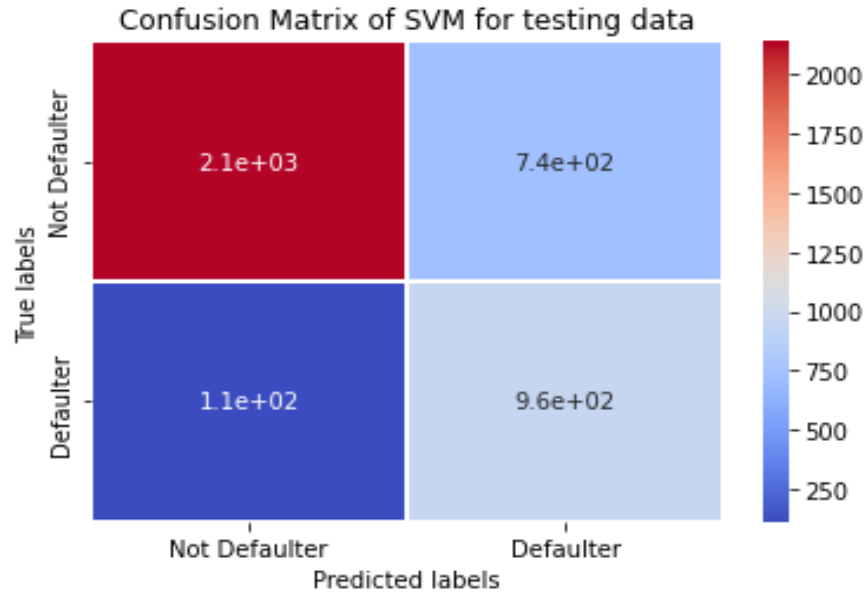
- We have implemented K-NN Classifier and we are getting accuracy score is approx 79%.
- Precision score approx is 57% and F1_score is 70%
- roc_auc approx is 82.33% and recall score is approx 90%
- Here, 1 denote the class for defaulters in AUC curve having value of 0.917

Support Vector Classifier

Confusion Matrix of SVM for testing data

Roc_auc_curve on testing data
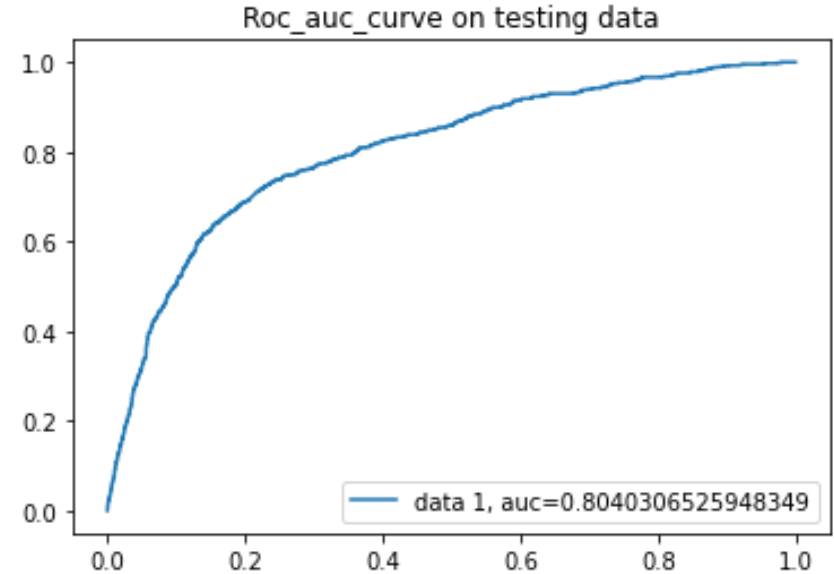
- We have implemented Support Vector Machine and we are getting accuracy score is approx 78%.
- Precision score approx is 58% and F1_score is 62.32%
- roc_auc approx is 75% and recall score is approx 68%.
- Here, 1 denote the class for defaulters in AUC curve having value of 0.804

XG Boosting

Confusion Matrix of XG Boosting for testing data

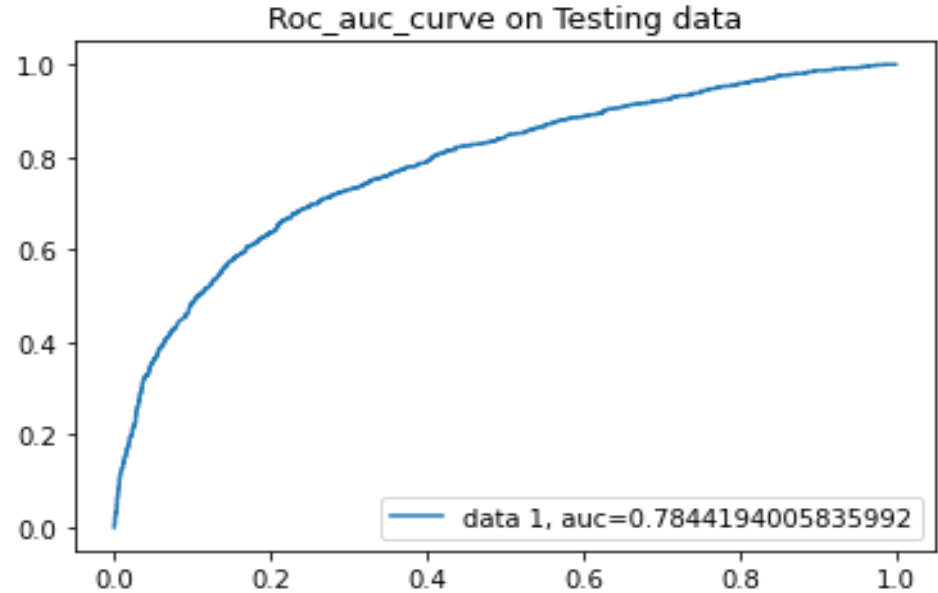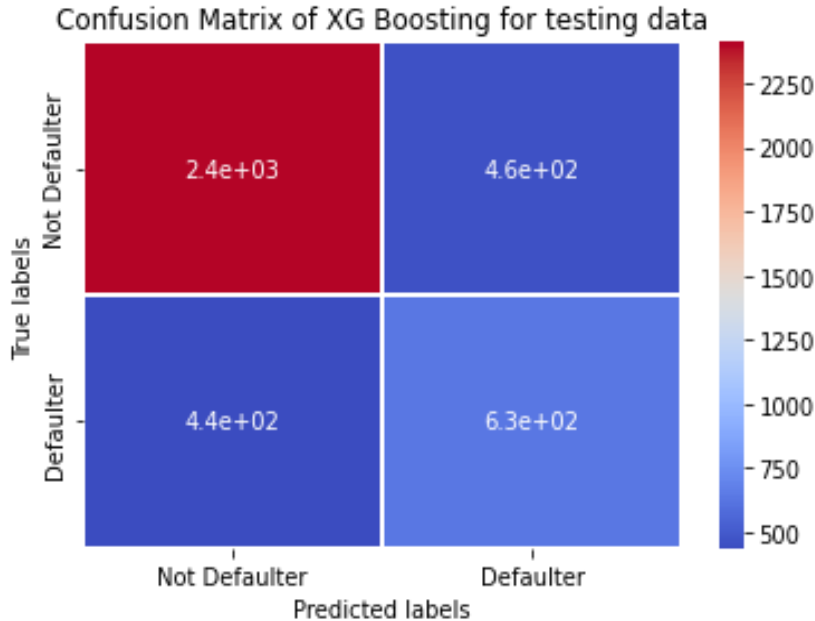Roc_auc_curve on Testing data

data 1, auc=0.7844194005835992
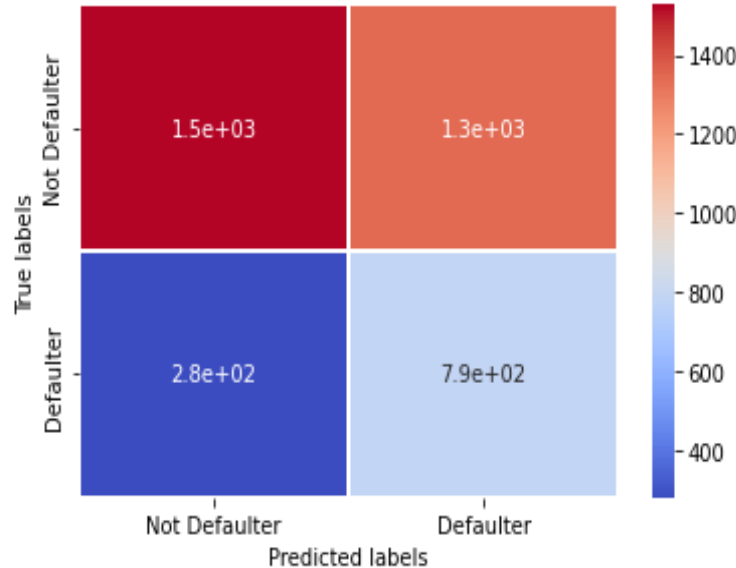
- We have implemented XG Boosting and we are getting accuracy score is approx 77%.
- Precision score approx is 57.45% and F1_score is 58%
- roc_auc approx is 71% and recall score is approx 58.26%
- Here, 1 denote the class for defaulters in AUC curve having value of 0.784

Decision Tree Classifier

Confusion Matrix of Gaussian Naive Bayes Classifier for testing data

Roc_auc_curve on Testing data

- We have implemented Decision Tree Classifier and we are getting accuracy score is approx 76%.
- Precision score approx is 55% and F1_score is 57.25%
- roc_auc approx is 71% and recall score is approx 60%
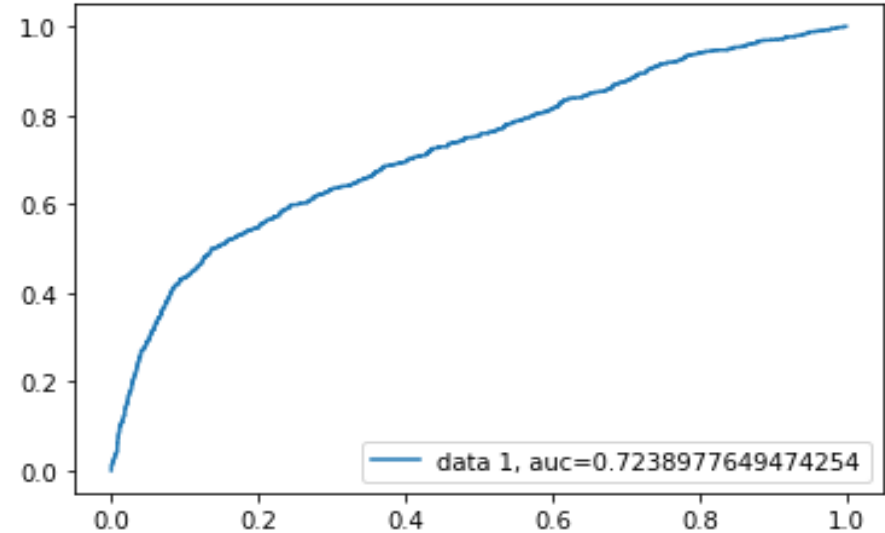- Here, 1 denote the class for defaulters in AUC curve having value of 0.723

Evaluation Metrics Table

Model_Name	Accuracy_Score	Precision_Score	Recall_Score	F1_Score	RUC_AUC_Score
Logistics regression	0.6860907017988346	0.4473023839397742	0.6657329598506069	0.5350844277673547	0.6797023630963743
Random Forest	0.8816822903470991	0.7755474452554745	0.7936507936507936	0.7844946931241347	0.8540576638629489
K-Neighbor Classifier	0.7881935647327084	0.5694034258712345	0.900093370681606	0.6975397973950795	0.8233081596106222
Support Vector Machine	0.777299214593362	0.5760697305863708	0.6788048552754435	0.6232318902700387	0.7463913010730486
XG Boosting	0.76969850051938181	0.574585635359116	0.5826330532212886	0.5785813630041725	0.7109966378762911
Decision Tree Classifier	0.7575373701545478	0.5488013698630136	0.5985060690943044	0.5725770433229119	0.7076327285666237

Conclusion

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• There is neither null nor duplicate values in our dataset.

• We rename the column for better understanding.

• We check the distribution of defaulter vs. non defaulter and we see that around 78% are non defaulter and 22% are defaulter.

•We have found the proportion of defaulters with respect to Marriage, Education, Sex feature and we found that :
•   Most of the defaulters are Female
•   Most of the defaulters are from university
•   Marital status is Single

•We have use the boxplot to detect the outliers and we see that there are so many outliers in the data so we ap ply IQR(Inter Quartile Range) which is one of the technique to remove outliers.

• We plot heat map to see the correlation between variables and we see that AGE and MARRIAGE columns are negatively correlated.

Conclusion

- **Random Forest Classifier** performs best among all models.
- **Logistic Regression** is not giving good precision score.
- Top 3 models are **Random Forest , K-Neighbor Classifier and Support Vector Classifier** that gives best Precision, Recall ,ROC_AUC and F1 score.

Thank you ....