Micro-Credit Defaulter Model

Submitted by: **PRATIK KUMAR**

ACKNOWLEDGMENT

This includes mentioning of all the references, research papers, data sources, professionals and other resources that helped you and guided you in completion of the project.

References:

1. Python Data Analysis: Perform data collection, data processing, wrangling, visualization, and model building using Python, 3rd Edition. by Avinash Navlani (Author), Armando Fandango (Author), Ivan Idris (Author)
2. Data Scrap doubt clearing session provided by FlipRobo.
3. Notes and classes by Data trained Academy.

INTRODUCTION

- Business Problem Framing

  (Describe the business problem and how this problem can be related to the real world.)

  I am doing this analysis for the company Microfinance Institution (MFI), who lend facilities to unbanked poor families living in remote area. Low-income population are the majority in a country like Indonesia and denied to finance by leading banks and Financial institutions.

  Our customer segment is the riskiest and more likely to default. Hence, it's important to identify the those who tend to default loan before approving.

  This project to predict transactors and delinquent customers, help micro finance institution to reduce delinquency and thereby improve business.

- Conceptual Background of the Domain Problem

  (Describe the domain related concepts that you think will be useful for better understanding of the project.)

The growth of new generation banks and small Micro finance institutions has been significant over last 2 decades. They have got attention by delivering microfinances to poor population.
Since they finance to the most unexplored segment ever, there is an exponential growth as well as hidden risk involved.

Under this circumstance, Machine Learning has its relevance by constantly monitoring repayment features of already funded customers and further lending will be based on Machine learning prediction.

- Review of Literature

(This is a comprehensive summary of the research done on the topic. The review should enumerate, describe, summarize, evaluate and clarify the research done.)

Poverty is a major problem in developing economies. Micro finance is the provision of financial service to poor with daily income. Only small fraction of people has access to financial instruments.

My study on Machine learning majorly focuses to identify customers who tend to default the micro credit facility. Payment features like Daily amount spent, Average main account balance, Average data account balance, No. of times the account is recharged, amount of recharge, No. of loans taken, Maximum loan amount and Average payback time are recorded for 30 days and 90 days period are the data input for evaluation.

Above said features were plotted to understand the general trend and noted observations, thereby deleted irrelevant features that doesn't contribute to the target and model was build.

- Motivation for the Problem Undertaken

(Describe your objective behind to make this project, this domain and what is the motivation behind.)

There is a growing interest in Micro Finance Institutions (MFI) as one of the avenues to enable low-income population to access financial services. With the growth of the sector in terms of both size and scope it needs more advanced technical regulations to sustain.

The motivation behind is the concern on sustainability of the growth rate and need for an optimized model for data evaluation.

Analytical Problem Framing

- Mathematical/ Analytical Modeling of the Problem

  (Describe the mathematical, statistical and analytics modelling done during this project along with the proper justification.)

  Every classification algorithm is built up with strong mathematical models and logic. The key challenge is to find out the appropriate algorithm for each application in machine learning.

  I have use statistical models to find insights given set of data. Predictions are assessed differently depending on its type: Based on the data structure of Target variable, Model type was identified. I have used classification metrics like Confusion matrix, Classification report and Accuracy score. I also have used error measures such as True Positive, False Positive etc. for classification problem.

  First and important step was to identify the model which was done by analyzing the target variable ‘label’. The feature consists only values “1” and “0”, which is ideal case of Binary classification and hence Classification algorithms were used. Best accuracy was achieved using Random Forest Classifier.

- Data Sources and their formats

(What are the data sources, their origins, their formats and other details that you find necessary? They can be described here. Provide a proper data description. You can also add a snapshot of the data.)

We have a Dataset of more than 2Lac sample/entries about customers who Loaned from their Mobile service provider and their repayment information.

Data Count : 209,593

Data Features 35

Data Types : int64, float64, object

Data sample:

	Unnamed: 0	label	msisdn	aon	daily_decr30	daily_decr90	rental30	rental90	last_rech_date_ma	last_rech_date_da	...	maxamnt_loans30	med
0	1	0	21408I70789	272.0	3055.050000	3065.150000	220.13	260.13	2.0	0.0	...	6.0	
1	2	1	76462I70374	712.0	12122.000000	12124.750000	3691.26	3691.26	20.0	0.0	...	12.0	
2	3	1	17943I70372	535.0	1398.000000	1398.000000	900.13	900.13	3.0	0.0	...	6.0	

Data Columns and data types:

```
Unnamed: 0                int64
label                     int64
msisdn                   object
aon                     float64
daily_decr30            float64
daily_decr90            float64
rental30                float64
rental90                float64
last_rech_date_ma       float64
last_rech_date_da       float64
last_rech_amt_ma          int64
cnt_ma_rech30             int64
fr_ma_rech30            float64
sumamnt_ma_rech30       float64
medianamnt_ma_rech30    float64
medianmarechprebal30    float64
cnt_ma_rech90             int64
fr_ma_rech90              int64
sumamnt_ma_rech90         int64
medianamnt_ma_rech90    float64
medianmarechprebal90    float64
cnt_da_rech30           float64
fr_da_rech30            float64
cnt_da_rech90             int64
fr_ma_rech90              int64
sumamnt_ma_rech90         int64
medianamnt_ma_rech90    float64
medianmarechprebal90    float64
cnt_da_rech30           float64
fr_da_rech30            float64
cnt_da_rech90           float64
cnt_loans30               int64
amnt_loans30              int64
maxamnt_loans30         float64
medianamnt_loans30      float64
cnt_loans90             float64
amnt_loans90              int64
maxamnt_loans90           int64
medianamnt_loans90      float64
payback30               float64
payback90               float64
pcircle                  object
pdate                    object
dtype: object
```

Except Telecom circle and Date all other columns are numeric datatypes.

There are no null values in the database.

- Data Preprocessing Done

  (What were the steps followed for the cleaning of the data? What were the assumptions done and what were the next actions steps over that?)

  ➢ Checked for null values and identified no null values in dataset.

  ➢ Values of some of the columns were check to get more insights and observed columns like ‘unnamed’, ‘msisdn’, ‘pcircle’ are irrelevant and hence removed the same.

  ➢ From total sample numbers 209593, and only 186243 are unique i.e. 23,350 duplicate mobile numbers. Retained the same as this consists of 11% of data and not more than 7-8% can be deleted.

  ➢ Outliers and skewness were checked.

- Hardware and Software Requirements and Tools Used

  Listing down the hardware and software requirements along with the tools, libraries and packages used. Describe all the software tools used along with a detailed description of tasks done with those tools.

  1. Lenovo flex corei5 laptop
  2. Jupyter Notebook - The Jupyter Notebook is an interactive environment for running code in the browser. It is a great tool for exploratory data analysis and is widely used by data scientists.
  3. MS PowerPoint - For preparing presentation of project.
  4. MS word - For preparing report
  5. Matplotlib - For data visualization to produce high quality plots, charts and graphs.
  6. Pandas - Python library for data wrangling and analysis. It is built around a data structure called Data Frame.
  7. NumPy - NumPy is one of the fundamental packages for scientific computing in Python.

Model/s Development and Evaluation

- Identification of possible problem-solving approaches (methods)

  I have use statistical models to find insights given set of data. Predictions are assessed differently depending on its type: Based on the data structure of Target variable, Model type was identified. I have used classification metrics like Confusion matrix, Classification report and Accuracy score. I also have used error measures such as True Positive, False Positive etc. for classification problem.

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- Testing of Identified Approaches (Algorithms)

  Build Models based on learning it was a supervised classification problem.

  I built 3 models to evaluate performance of each of them:

  a. Logistic Regression
  b. Random forest Classifier
  c. Decision Tree Classifier

  Since the data was imbalanced, I used metrics like precision, recall and ROC-AUC curve.

- Run and Evaluate selected models

Describing all the algorithms used along with the snapshot of their code and what were the results observed over different evaluation metrics.

1. LOGISTC REGRESSION

```
# logistic regression object
lr = LogisticRegression(solver='lbfgs', max_iter=400)

# train the model on train set
lr.fit(x_train, Y_train)
lr.score(x_train, Y_train)

predictions = lr.predict(x_test)
```

- Key Metrics for success in solving problem under consideration

  The key metrics used:

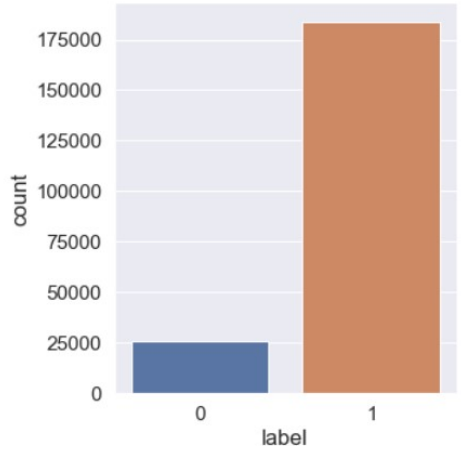
  1. Confusion Metrics
  2. Classification Report
  3. Accuracy score

```
print("Confusion Matrix:",confusion_matrix(Y_test, prediction2))
print("Classification Report:",classification_report(Y_test, prediction2))
print("Accuracy score:",accuracy_score(Y_test, prediction2))
```

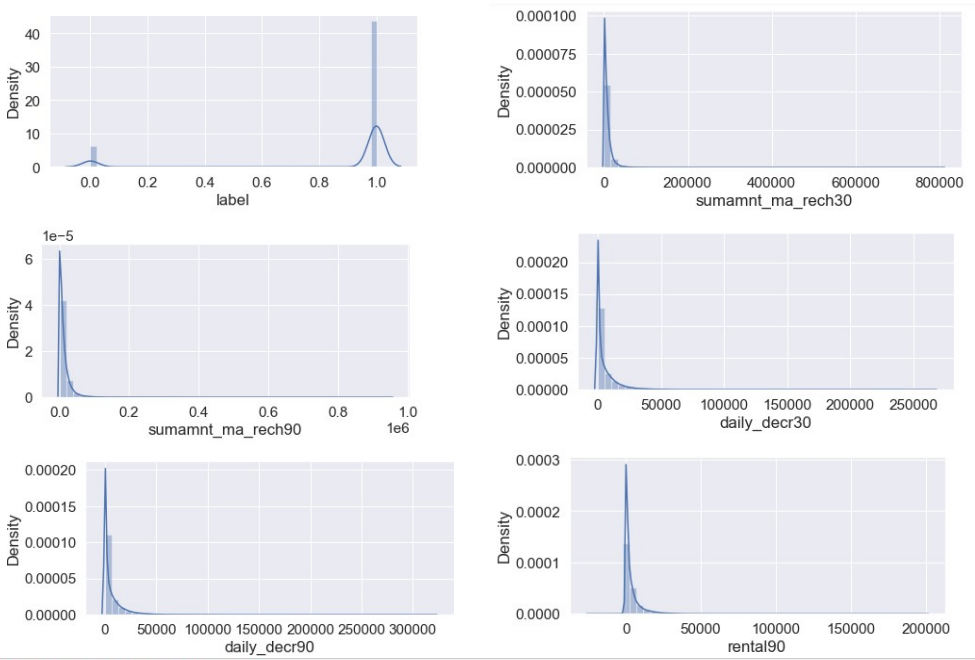
- Visualizations & Interpretation of the Results

  Summary of what results were interpreted from the visualizations, preprocessing and modelling.

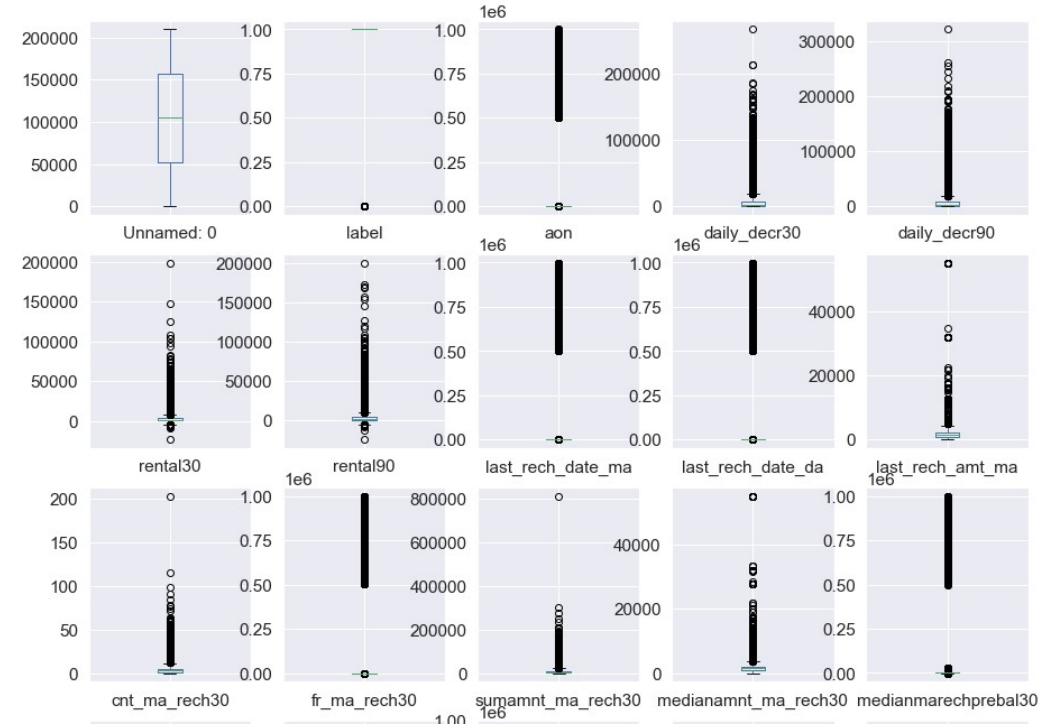
```
# Plotting target variable.
sns.catplot(x='label', data=df, kind='count')
plt.show()
```



It was observed that the dataset was imbalanced for the target feature(87.5% for Non-defaulters and 12.5% for Defaulters)

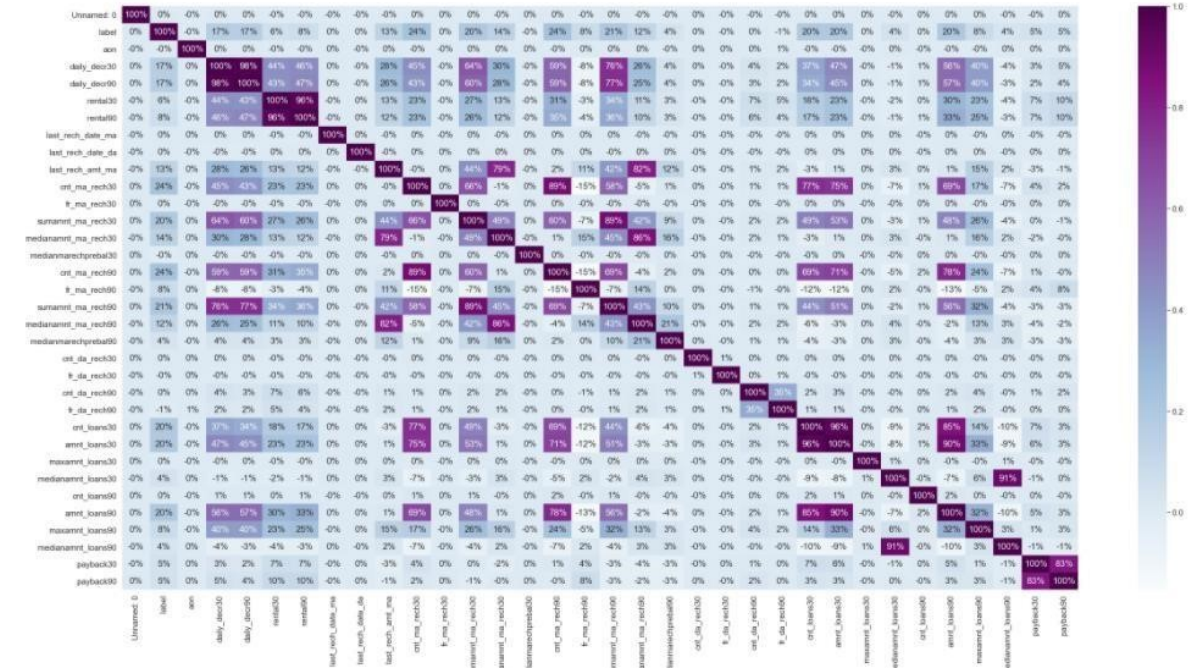



```
# Checking outliers with boxplot.
df.plot(kind='box', figsize=(15,30), layout =(8,5), sharex=False, subplots=True)
plt.show()
```



```
#Heatmap to know correlation between attributes.
correlations = df.corr()
plt.figure(figsize=(40,20))
sns.set(font_scale=1.4)
sns.heatmap(correlations, data=df, annot=True, fmt='.0%',cmap="BuPu")
```

```
<AxesSubplot:>
```



Analyzing the heatmap,

1. Target variable 'label' has no correlation more than 30% with any features.
2. 'label' has 24% correlation with count of main account got recharged in last 30 days and 90 days.

On visualizing data, there were two important insights I gathered.

a. Imbalance of data

b. Distribution was not normal

Data Normalization Since the data was not normal, I normalized all the features except the target variable.

Instead of under sampling the majority class. I chose to oversample the minority class using SMOTE.

CONCLUSION

- Key Findings and Conclusions of the Study

  According to the performance metrics, Random Forrest scores highest in accuracy. Also, the curve is tending towards the ideal shape. Hence, Random Forrest looks like the best fit for this data.

  Learning Outcomes of the Study in respect of Data Science

  - ➢ Learnt about sampling technique and technique to perform oversampling with smote and installing smote as well.
  - ➢ I have also learnt to perform normalization.
  - ➢ Major challenge faced was during Feature reduction, I couldn't perform it properly and hence avoided the step.

- Limitations of this work and Scope for Future Work

  Techniques can be followed to further,

  1. Dimensionality reduction.
  2. Better dealing with outliers.