Pitney Bowes Data Challenge

Baruch College

Team 8

About us

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Business Understanding

Pitney Bowes is one of the leading solution providers in Postage Meters, which allows businesses to simplify their shipping and mailing process.

VALUE PROPOSITION

Help customer:
- Save time (skip the Post Office and easily buy and print USPS® postage)
- Save money (access to discounted postage)

CUSTOMER SEGMENT

Businesses who ship large quantities of mail through the USPS

REVENUE STREAM

-Direct sales (selling postage meter equipment)
-Subscription plan (month posting printing fee)

COST STRUCTURE

-Production and maintenance cost of postage meters
-Labor cost
-Selling & marketing cost
-Research, Development & Intellectual Property cost

GOAL

Predict which meters will fail within the next 7 days to reduce down-time risks of meters deployed at Pitney Bowes' customers to avoid any sort of disruption

ML TASK

- Categorization
- Input: 54 attributes providing information regarding charge/discharge, restart times, time-off...
- Output: fail_7

OFFLINE EVALUATION

Apply:
- PCA method to select significant variables
- ML methods for classification (random forest, KNN, Naive Bayes...) to build prediction model

DATA SOURCE

Train set & test set provided by Pitney Bowes

Data Understanding

Train Set

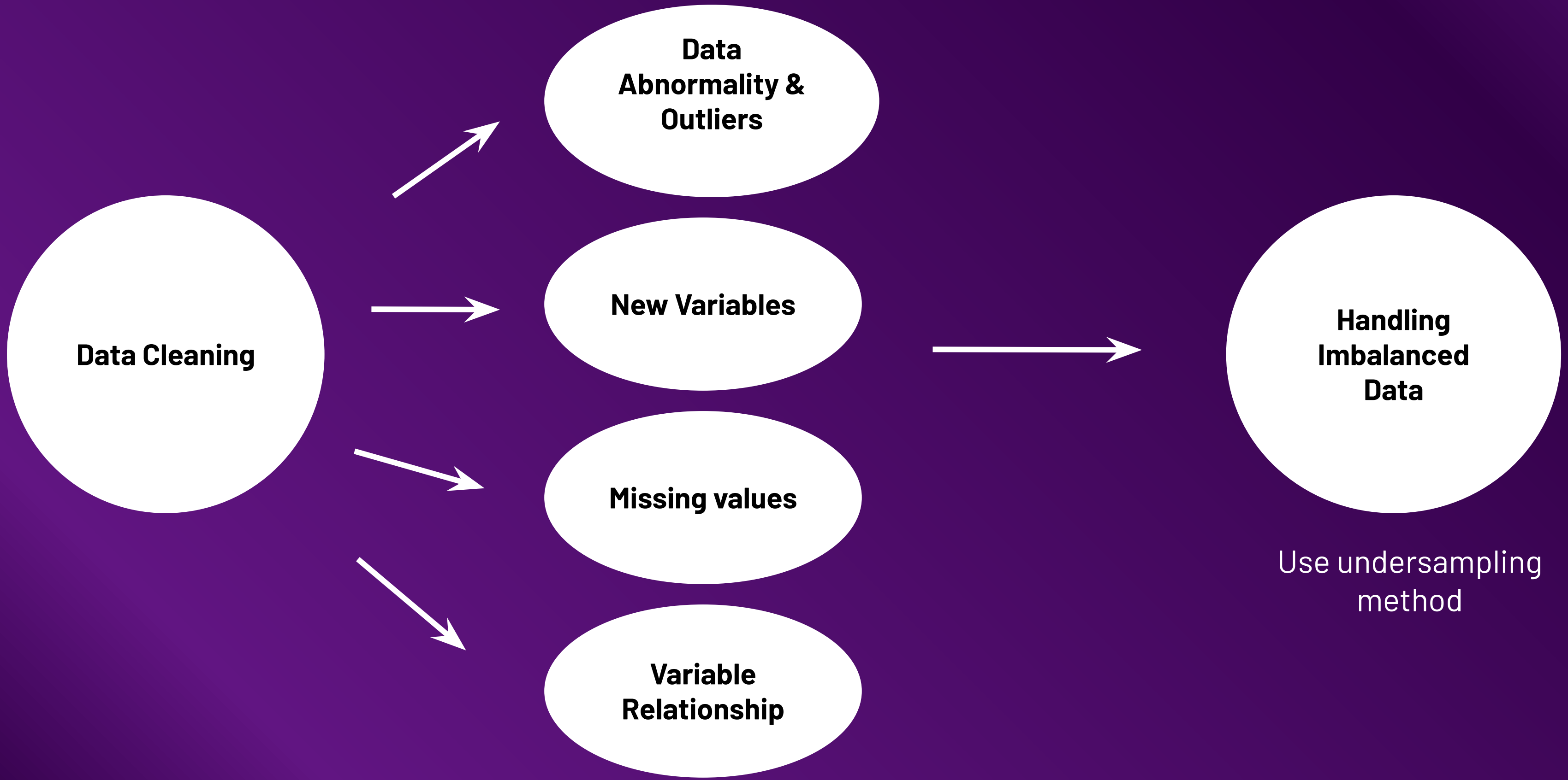
Test Set

40,500 records and 55 attributes

4,500 records and 54 attributes

New added variables: Life_of_device and Total_off_life

Data Preparation



Modelling Process

01 — Prepare Training Data after Feature Engineering

02 — Fitting Classification Algorithms

03 — Apply PCA with data set and fit model

04 — Select model with highest accuracy score

Feature Engineering

Get dummy

charge_cycle_time_below_12 is transformed into a dummy variable.

Check multicollinearity

- Using VIF score to quantify the extent of correlation between one predictor and the other predictors.

- Remove variables with VIF > 10

Scale data

- Standardization scale

Model Fitting

Random Forest
Accuracy: **68.60%**

Logistic Regression
Accuracy: **66.95%**

SVM (Linear)
Accuracy: **67.85%**

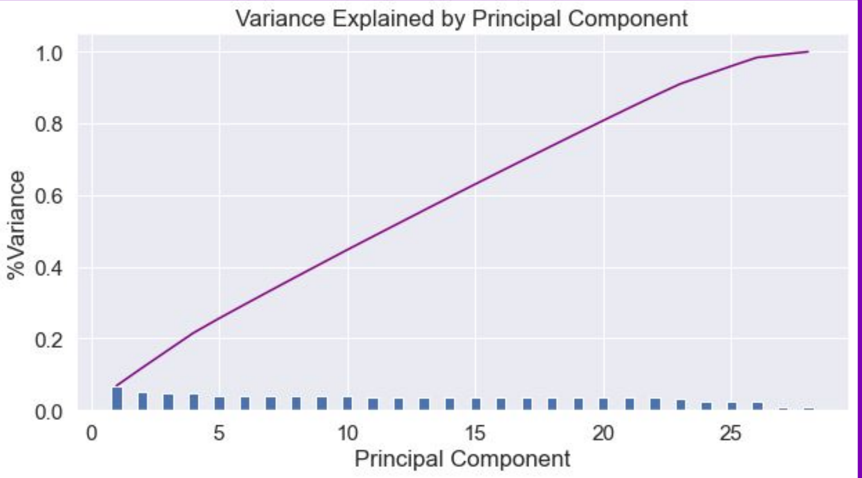
Naive Bayes
Accuracy: **66.96%**

Kernel SVM
Accuracy: **67.19%**

Decision Tree
Accuracy: **59.50%**

Knn
Accuracy: **56.55%**

Principal Component Analysis

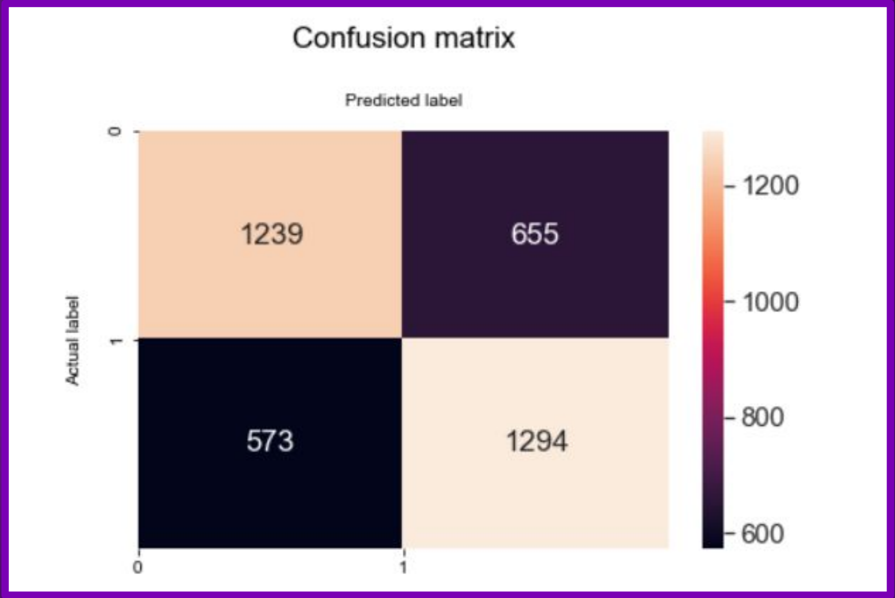


	Model	Accuracy	Precision	Recall	F1 Score
0	Kernel SVM	0.540282	0.531025	0.632566	0.577365
1	Logistic Regression	0.528849	0.524548	0.543653	0.533930
6	Random Forest	0.521138	0.518415	0.497590	0.507789
2	Naive Bayes	0.524860	0.517778	0.623996	0.565946
3	SVM (Linear)	0.521670	0.517764	0.530798	0.524200
4	Decision Tree	0.514225	0.510893	0.502410	0.506616
5	KNeighbors	0.512098	0.507561	0.575254	0.539292

Keep 23 Principal Components as they explain more than 90% variance of the data

The accuracy score is lower than the original data set

Model Selection



Random Forest

k-fold Cross Validation results indicate that we would have an accuracy anywhere between 65% to 69%

Precision: 66.40%
Recall: 69.30%

Improvement

69%

Low Accuracy Score

50%

Data Reduced After Balance

48%

Failed Machine - Unrealistic

Recommendations

TO DO LIST	
Task 1	Dealing with imbalanced data without losing many observations
Task 2	Better feature engineering to have higher accuracy score
Task 3	Running model to specific types of machines to increase accuracy

Thanks!