

Insurance Fraud Detection Using Machine Learning

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16/12/2021



Outline

- ✓ Executive Summary
- ✓ Introduction
- ✓ Methodology
- ✓ Results
- ✓ Conclusion
- ✓ Appendix



Executive Summary

✓ Summary of methodologies

- ✓ Extract Transform Load(ETL)
- ✓ Data Cleaning
- ✓ Feature Engineering
- ✓ Model Definition
- ✓ Model Training
- ✓ Model Evolution
- ✓ Model Deployment

✓ Summary of all results

- ✓ Exploratory data analysis
- ✓ Anomaly Detection
- ✓ Result of all Classification Algorithms
- ✓ Voting Classifier Results
- ✓ XGB Classifier-Grid Search Result
- ✓ Model Performance
- ✓ Confusion Matrix Outcomes
- ✓ Accuracy after Dimension Reduction



About The Author



VEER PAL SINGH

I have been a professional Data Scientist now since leaving my career as a Business Analytics and Six sigma Black Belt Management Consultant. Also I have coached more than 3000 professionals in the field of Statistics, Quantitative Techniques and Data Analytics.

Introduction



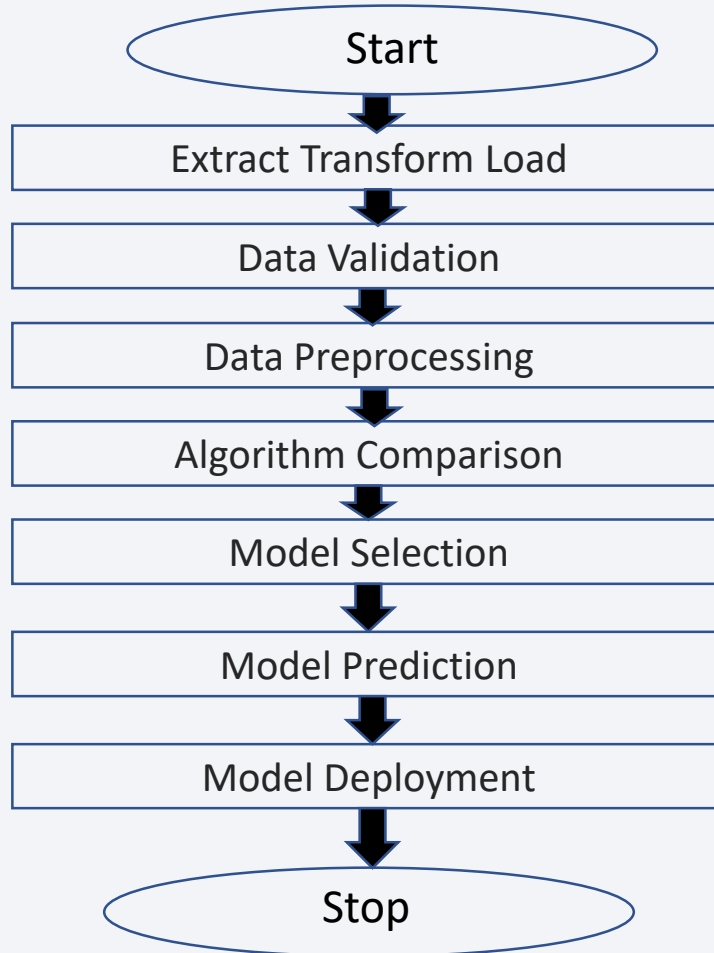
Project background and context

- ✓ In 2019, fraudulent insurance claims costed insurance companies in the United Kingdom £1.2 billion alone. Today, we see a rise in insurance fraud particularly in the property, automotive and healthcare sectors.
- ✓ With Accenture naming insurance as the industry most susceptible to future disruption, insurance companies need to adopt digital innovations urgently to reduce instances of fraudulent claims and better prepare for future threats.

Problems that need to be solved?

- ✓ How can AI, and machine learning more specifically, help your organization detect insurance fraud more effectively?.

Methodology



- ✓ Collected Data “insurance_claims.csv” From Kaggle dataset “
- ✓ Classification is performed using the XGBoost (eXtreme Gradient Boosting) algorithm.
- ✓ Make prediction for the test data and evaluate
- ✓ The XGB model provide improved performance @82.5%

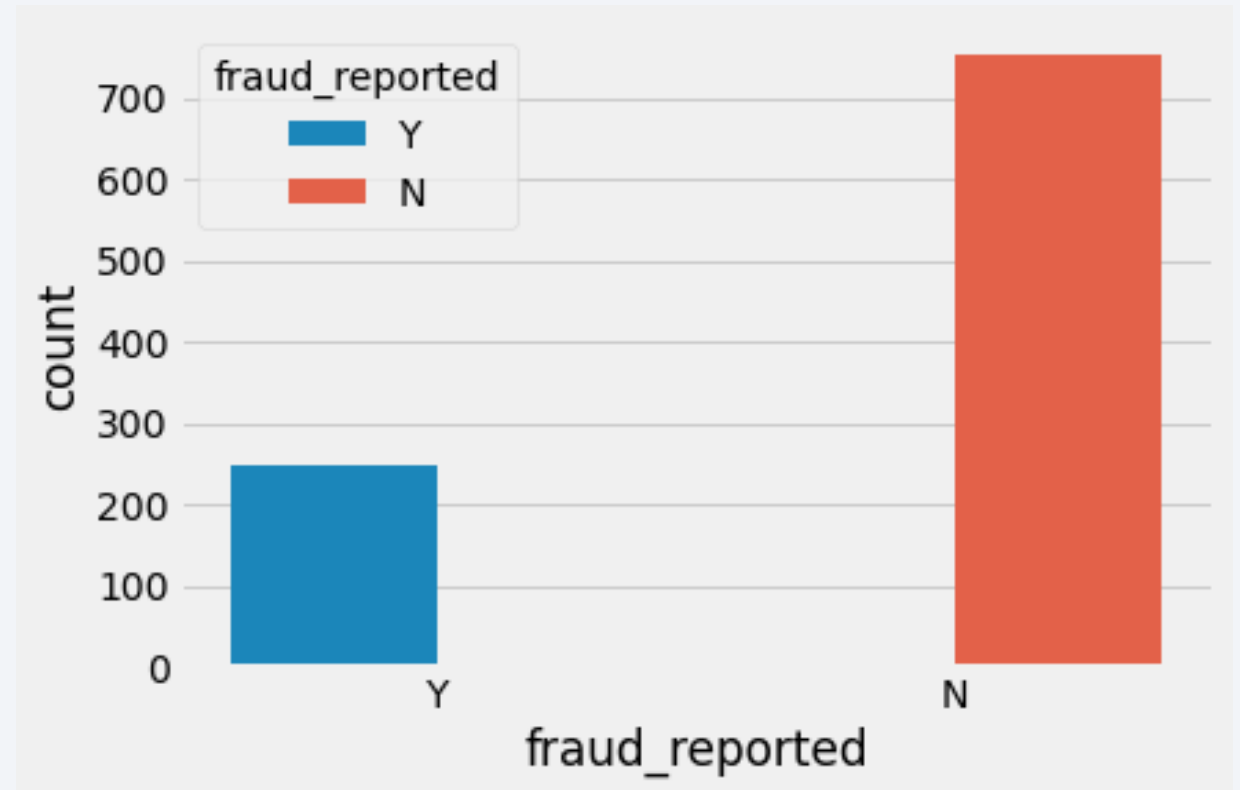
Insights drawn from EDA Analysis



Insights drawn from EDA Analysis

Exploratory data analysis

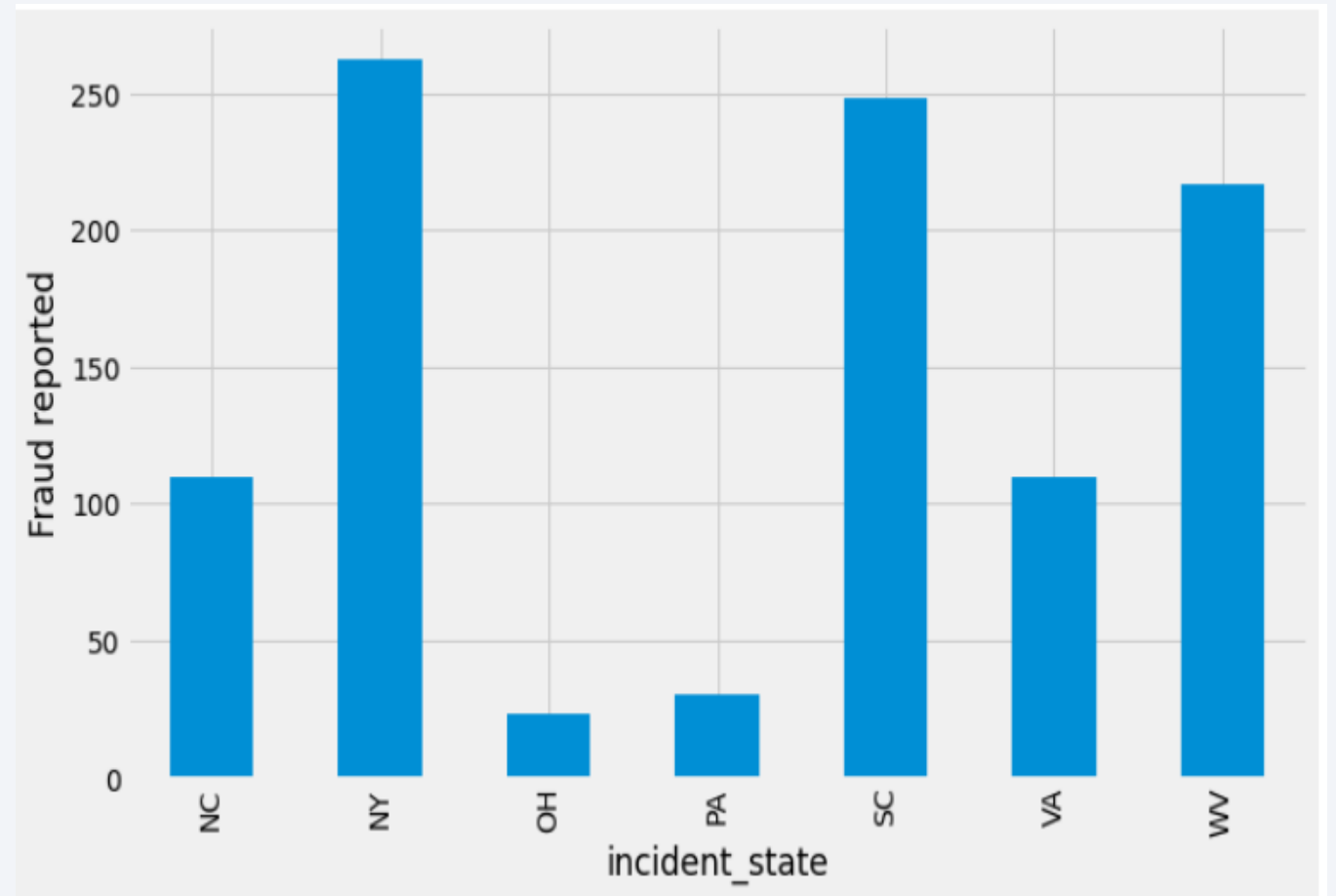
Exploratory data analysis was conducted starting with the dependent variable, Fraud reported. There were 247 frauds and 753 non-frauds. 24.7% of the data were frauds while 75.3% were non-fraudulent claims.



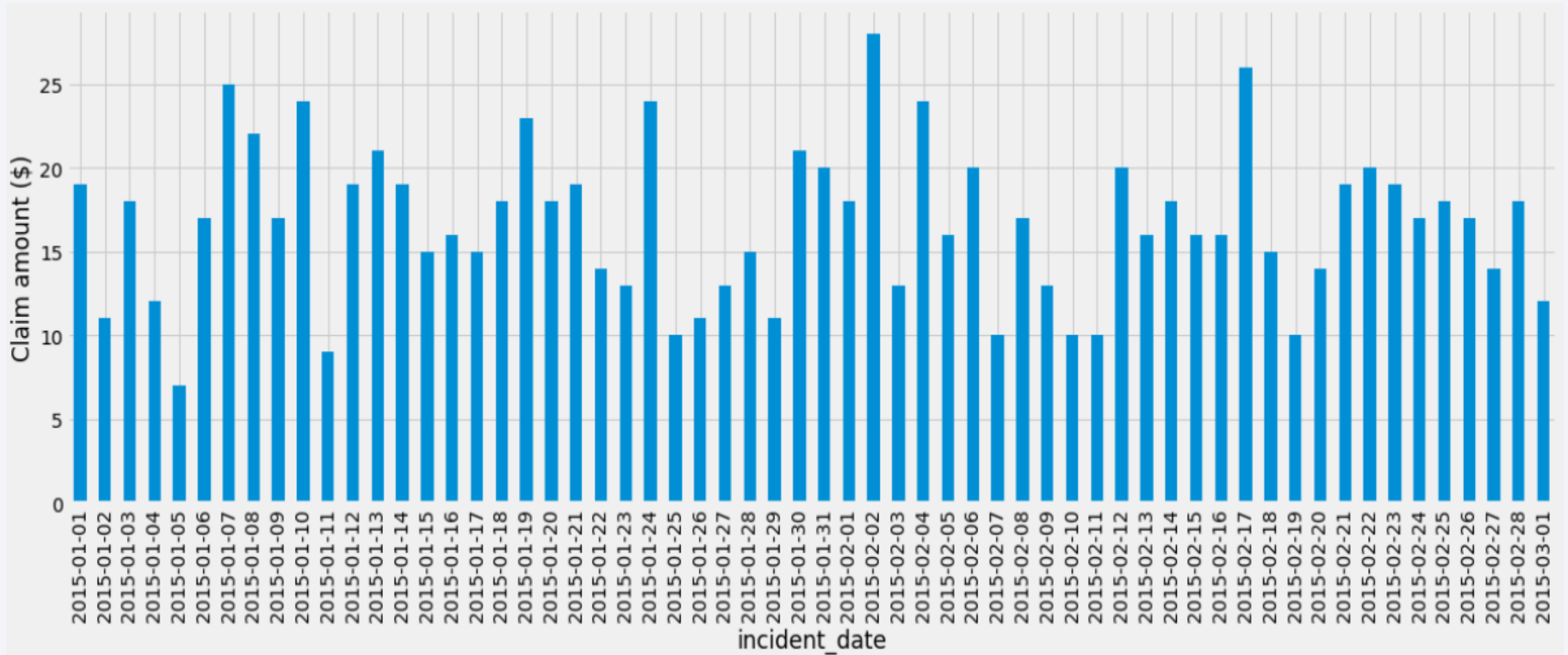
Insights drawn from EDA Analysis

State wise Claim Reported

NY	262
SC	248
WV	217
VA	110
NC	110
PA	30
OH	23

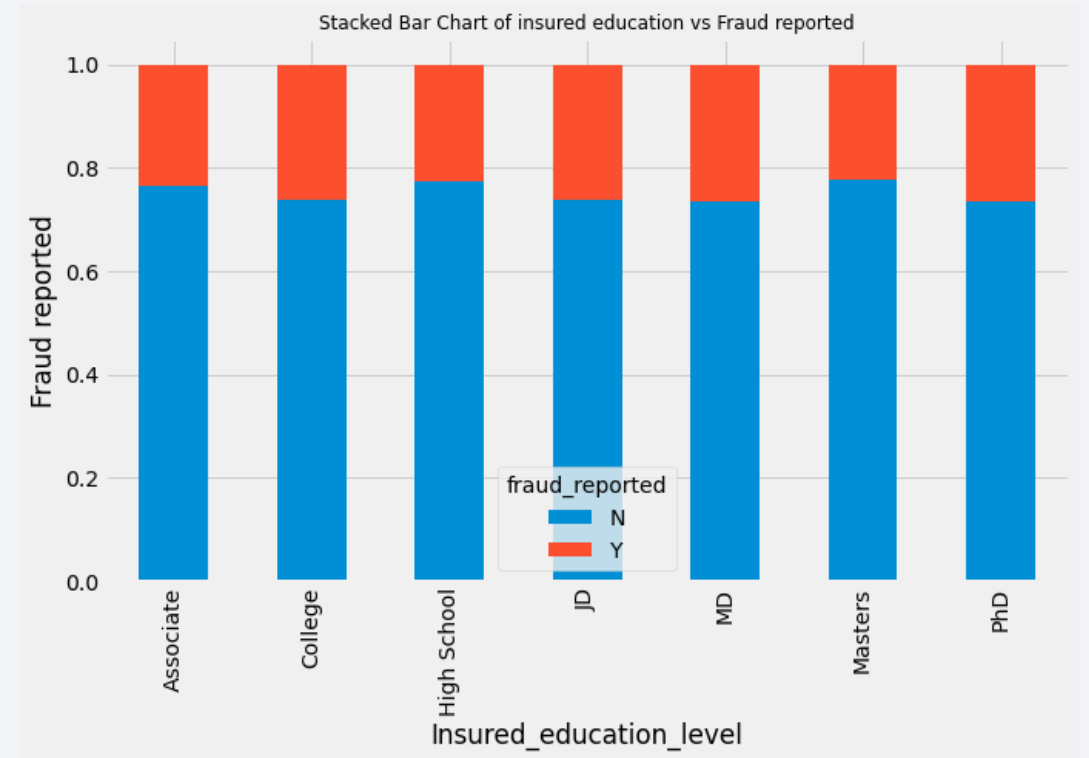
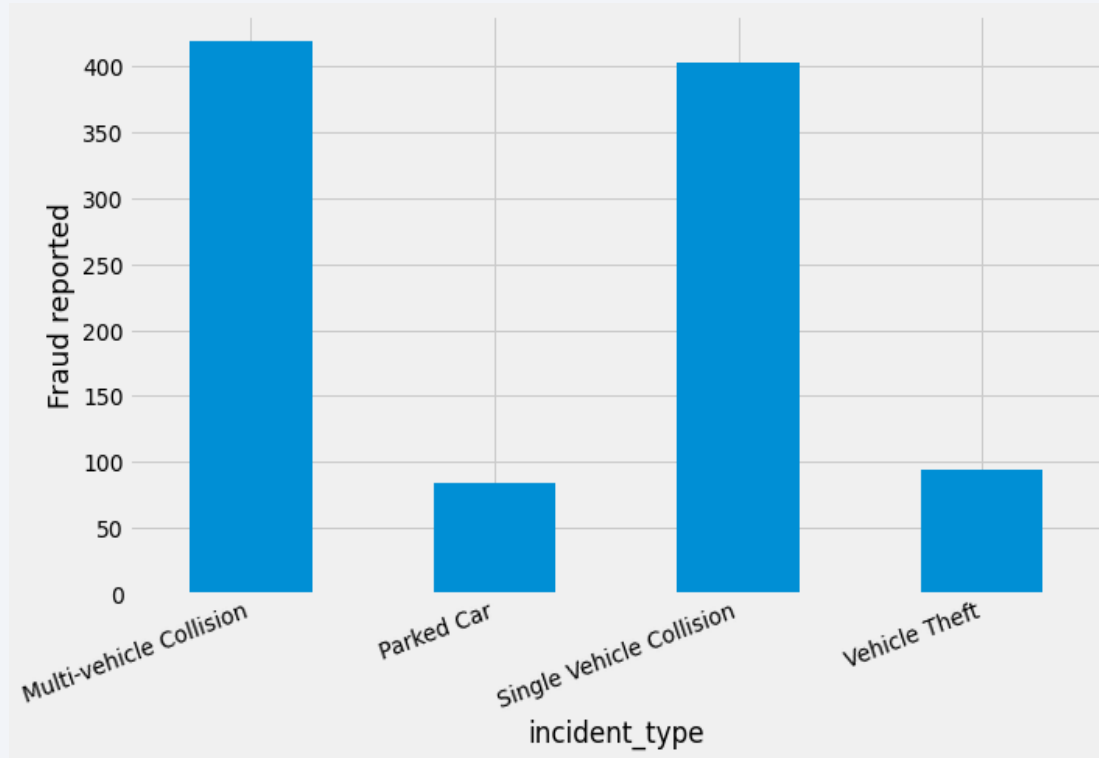


Insights drawn from EDA Analysis

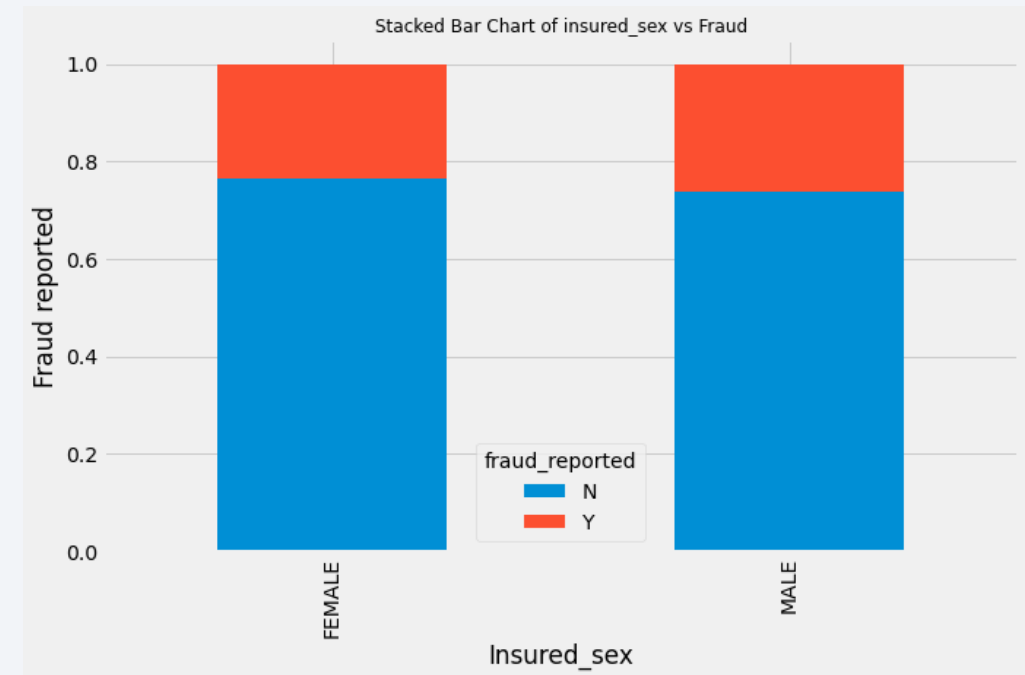
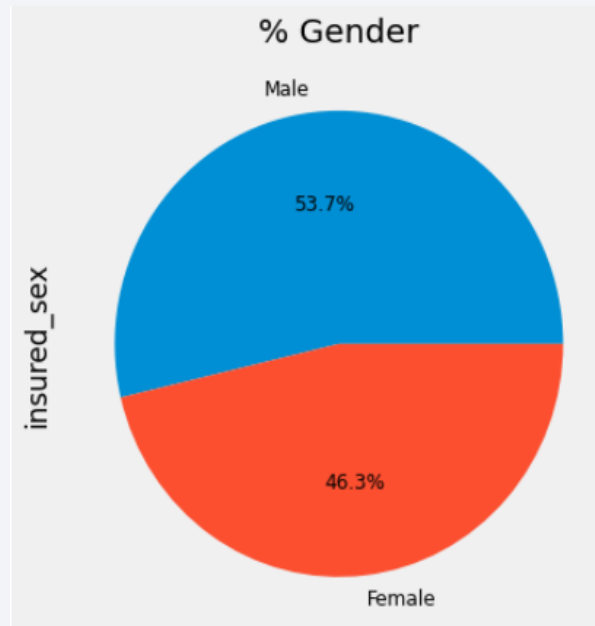


Date wise insurance claim reported

Insights drawn from EDA Analysis

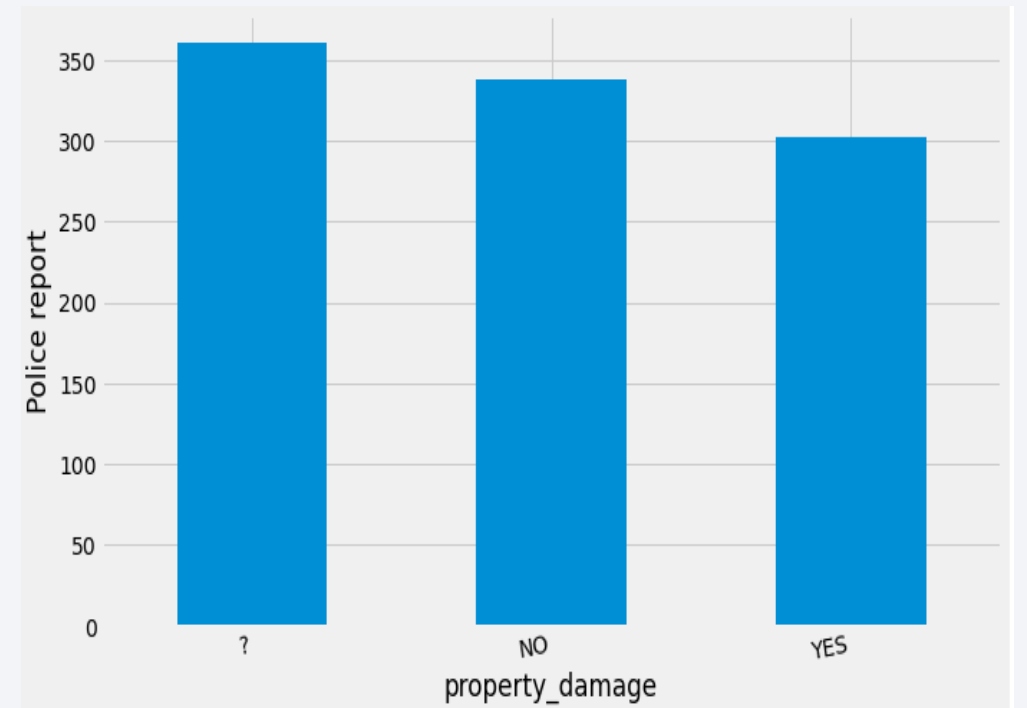
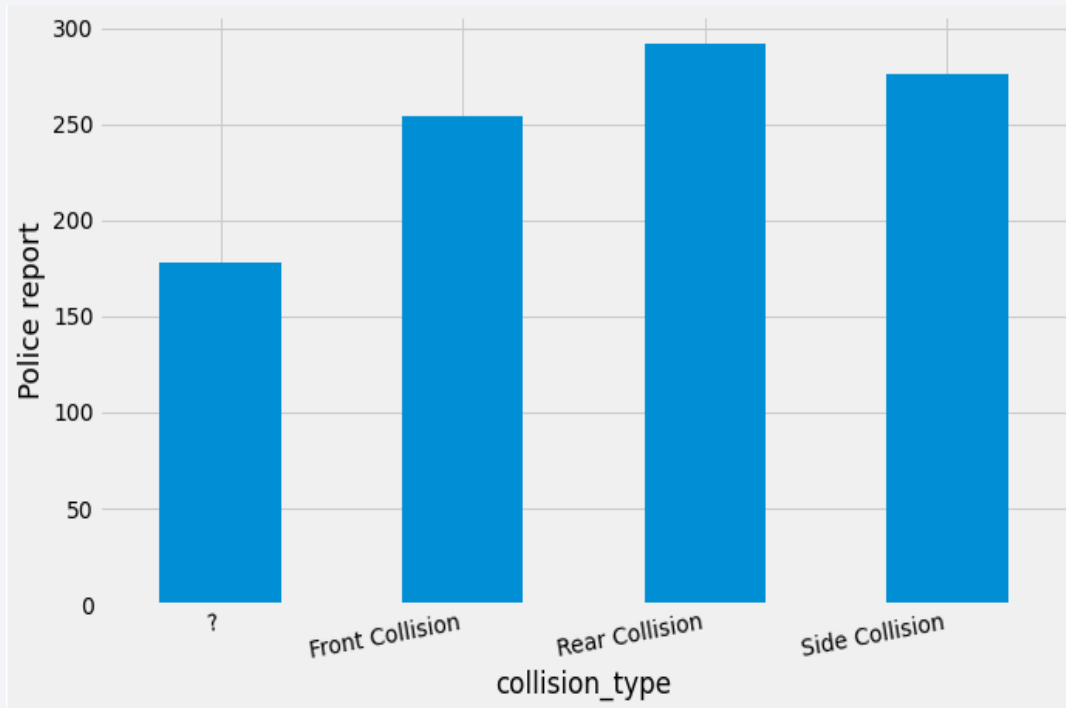


Insights drawn from EDA Analysis



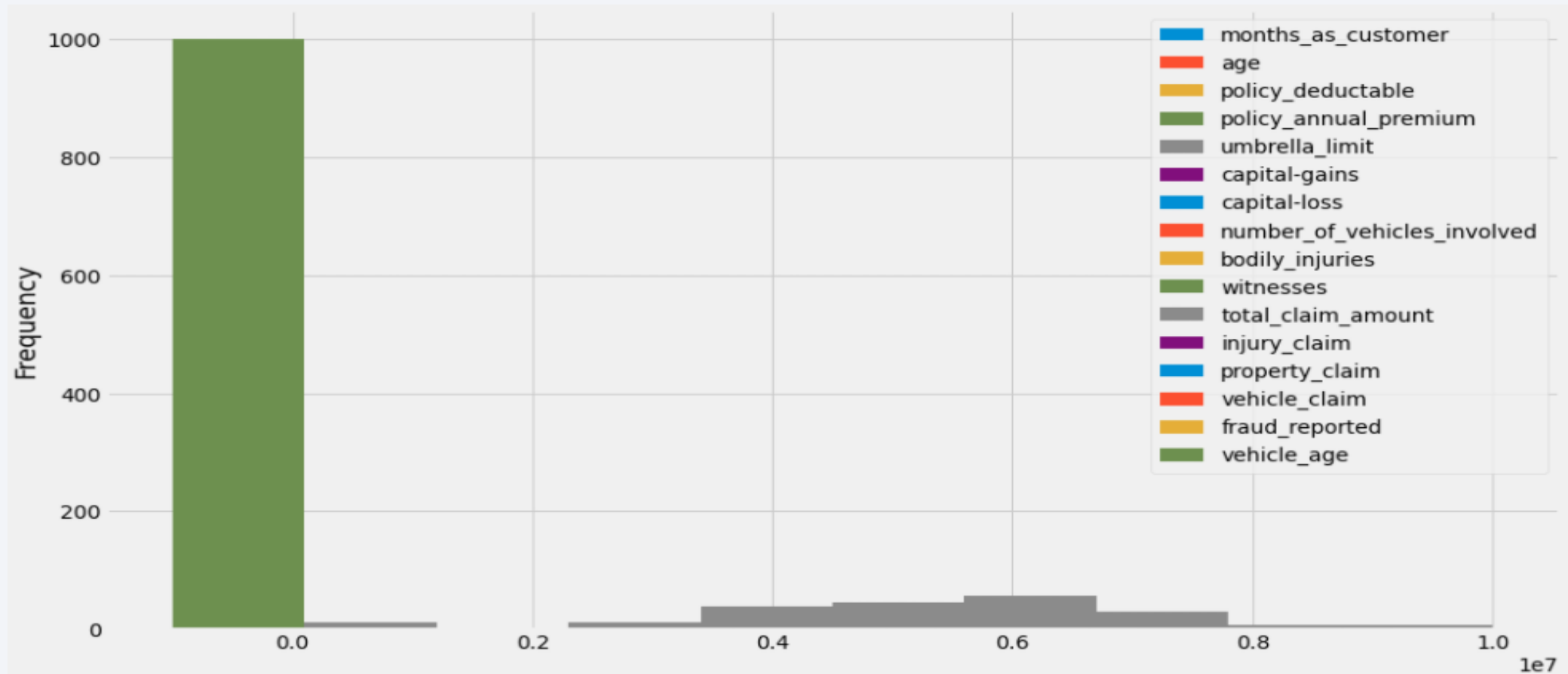
Gender wise Claim

Insights drawn from EDA Analysis



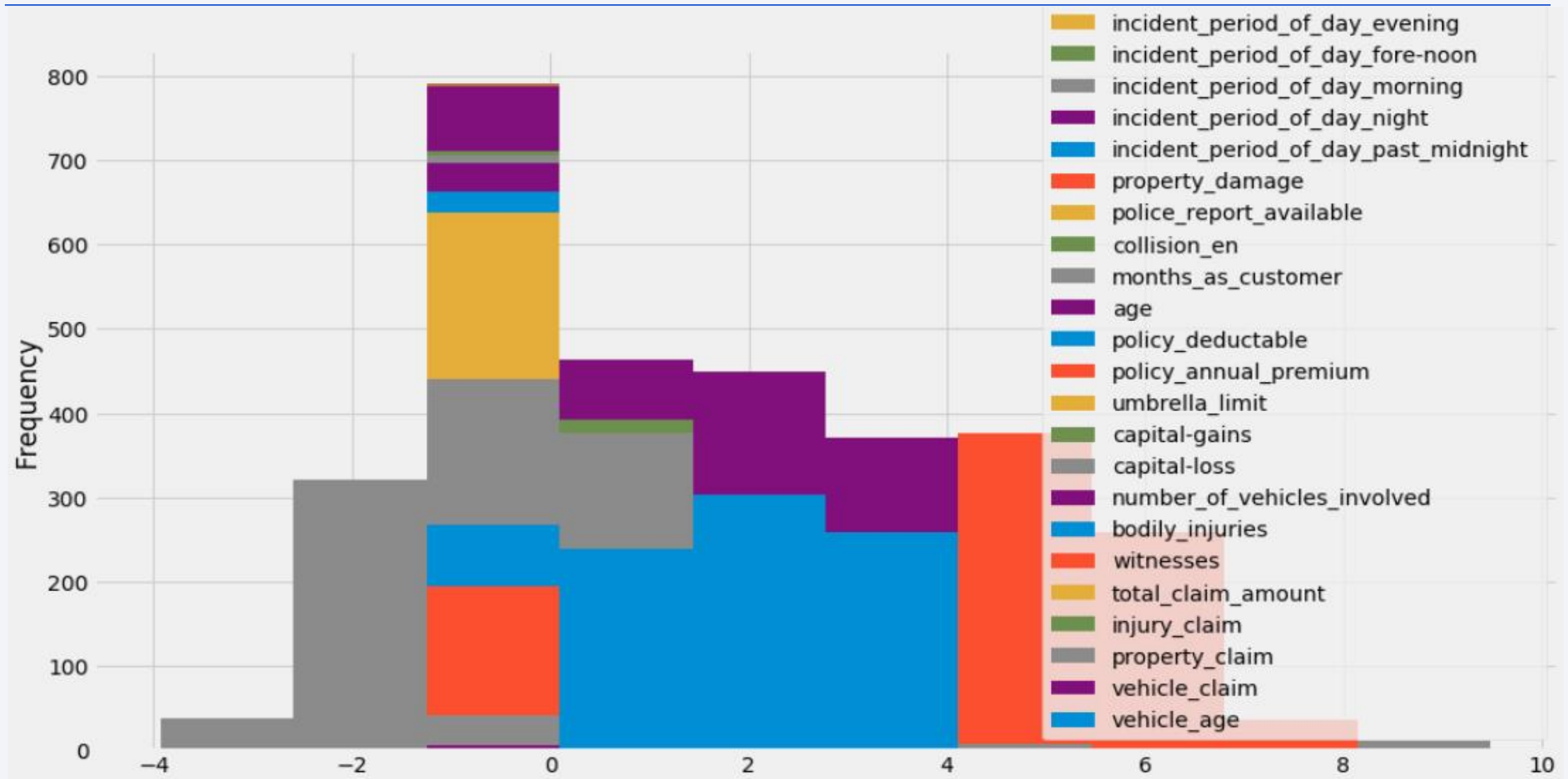
Collision type and total damage report

Anomaly Detection



The green bar standing tall and away from all, signifies anomalies in either of policy_annual_premium, witnesses or vehicle_age. Let's draw box-and-whisker plot on each to check the presence of outliers

Histogram Plot on scaled data to check Anolalies

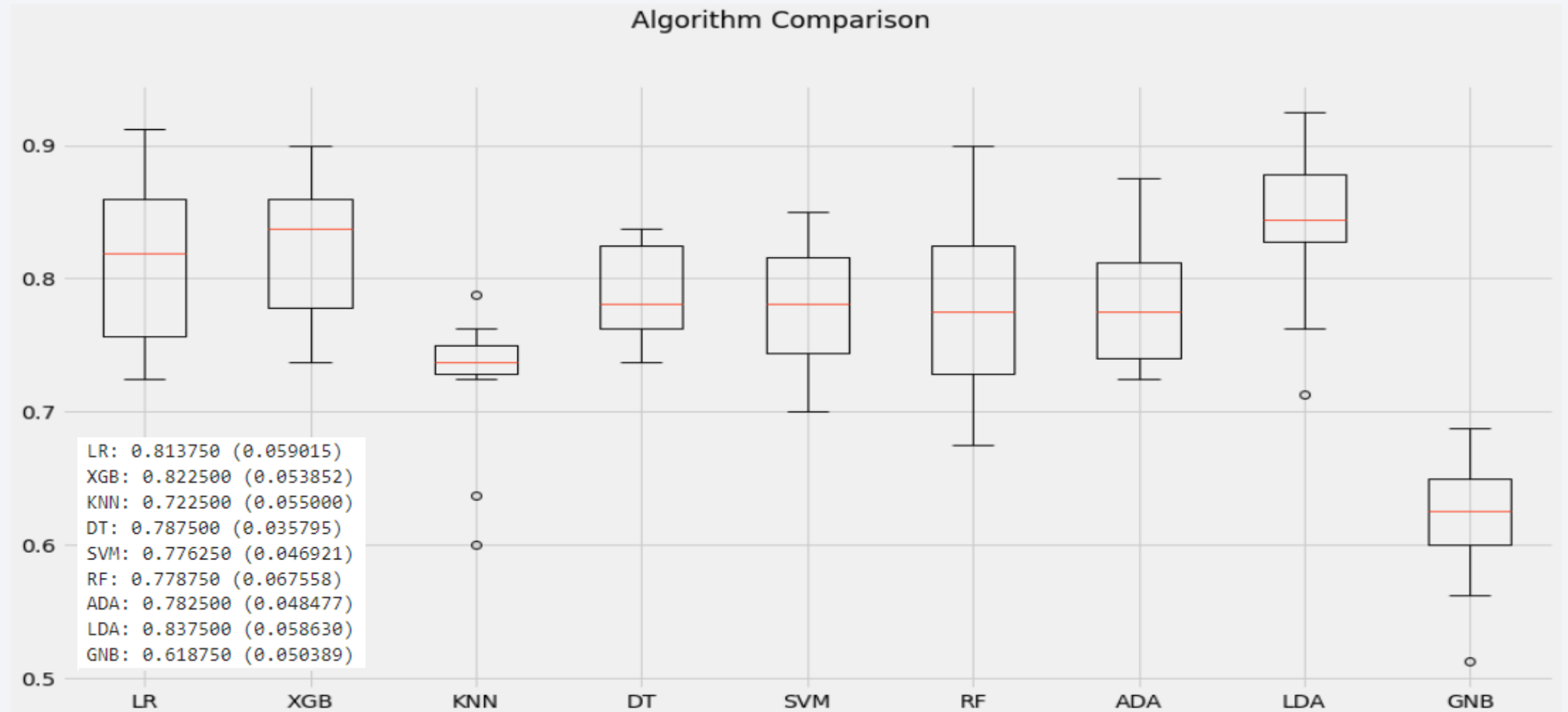


Features	F score
property claim	111.0
months_as_customer	94.0
injury_claim	91.0
vehicle_age	85.0
capital_loss	82.0
incident_severity_Major Damage	71.0
total_claim_amount	58.0
vehicle_claim	55.0
witnesses	47.0
insured_hobbies_chess	45.0
age	39.0
bodily_injuries	37.0
insured_hobbies_loss_fit	25.0
collision_en	24.0
police_report_available	20.0
policy_deductable	16.0
incident_state_SC	14.0
number_of_vehicles_involved	1.0
csf_per_person_100	1.0
insured_relationship_own-child	1.0
insured_relationship_other-relative	1.0
insured_sex_FEMALE	1.0
authorities_contacted_Other	1.0
policy_state_IL	1.0
umbrella_limit	1.0
insured_education_level_High School	1.0
incident_state_NC	1.0
authorities_contacted_Police	1.0
property_damage	1.0
incident_state_WY	1.0
authorities_contacted_Ambulance	1.0
insured_education_level_MD	1.0
authorities_contacted_Fire	1.0
incident_type_Multi-Vehicle Collision	1.0
incident_period_of_day_past-midnight	1.0
incident_period_of_day_afternoon	1.0
csf_per_person_500	1.0
auto_make_Nissan	1.0
incident_period_of_day_night	1.0
incident_city_Columbus	1.0
incident_type_Single-Vehicle Collision	1.0
insured_relationship_not-in-family	1.0
insured_relationship_husband	1.0
insured_education_level_Phd	1.0
insured_education_level_Associate	1.0
incident_period_of_day_fore-noon	1.0
incident_period_of_day_early-morning	1.0
auto_model_Ford	1.0
incident_city_Northbrook	1.0
incident_city_Hillsdale	1.0
incident_state_VA	1.0
insured_hobbies_paintball	1.0
insured_hobbies_camping	1.0
insured_occupation_armored-forces	1.0
auto_model_Passat	1.0
auto_model_Malibu	1.0
incident_city_Springfield	1.0
incident_city_Riverwood	1.0
insured_hobbies_video-games	1.0
insured_hobbies_kayaking	1.0
insured_hobbies_base-jumping	1.0
insured_occupation_tech-support	1.0
insured_occupation_machine-op-inspct	1.0
insured_occupation_handlers-cleaners	1.0
insured_education_level_Masters	1.0
insured_education_level_ID	1.0
incident_period_of_day_evening	1.0
auto_model_Wrangler	1.0
auto_model_Civic	1.0
auto_make_Volkswagen	1.0
auto_make_Audi	1.0
incident_severity_Minor Damage	1.0
insured_occupation_prof-specialty	1.0
incident_period_of_day_morning	1.0
auto_model_X6	1.0
auto_model_RAM	1.0
auto_model_Pathfinder	1.0
auto_model_Neon	1.0
auto_model_Legacy	1.0
auto_model_Jetta	1.0
auto_model_Grand Cherokee	1.0
auto_model_Camry	1.0
auto_make_Toyota	1.0
auto_make_Subaru	1.0
auto_make_Saab	1.0
incident_severity_Total Loss	1.0
incident_type_Parked Car	1.0
insured_hobbies_sleeping	1.0
insured_hobbies_reading	1.0
insured_hobbies_pole	1.0
insured_hobbies_basketball	1.0
insured_occupation_protective-serv	1.0
insured_occupation_farming-fishing	1.0
insured_occupation_adm-clerical	1.0
insured_education_level_College	1.0

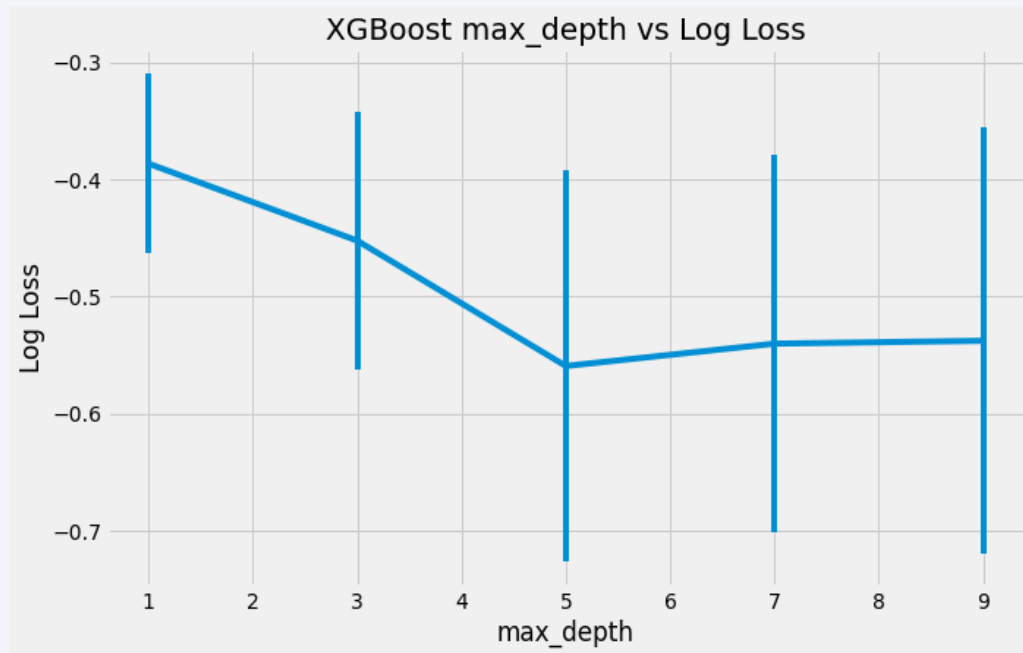
Predictive Analysis



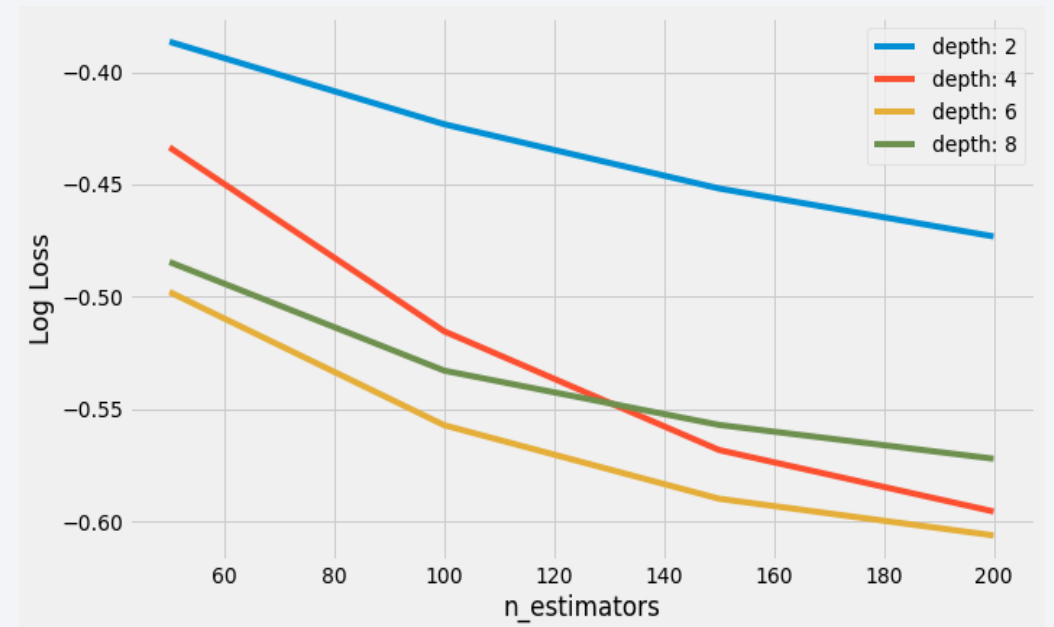
Model Selection



Model Fitting



We can see the log loss for each max_depth. The optimal configuration is max_depth=1 resulting in a log loss of 0.3865.



We see here that, the best result was achieved with a n_estimators=50 and max_depth=2

Model Prediction for Test Data

The XGB model provides improved performance @ 82.5% with fitted model (which means 1 in every 18 fraud reported are incorrect).

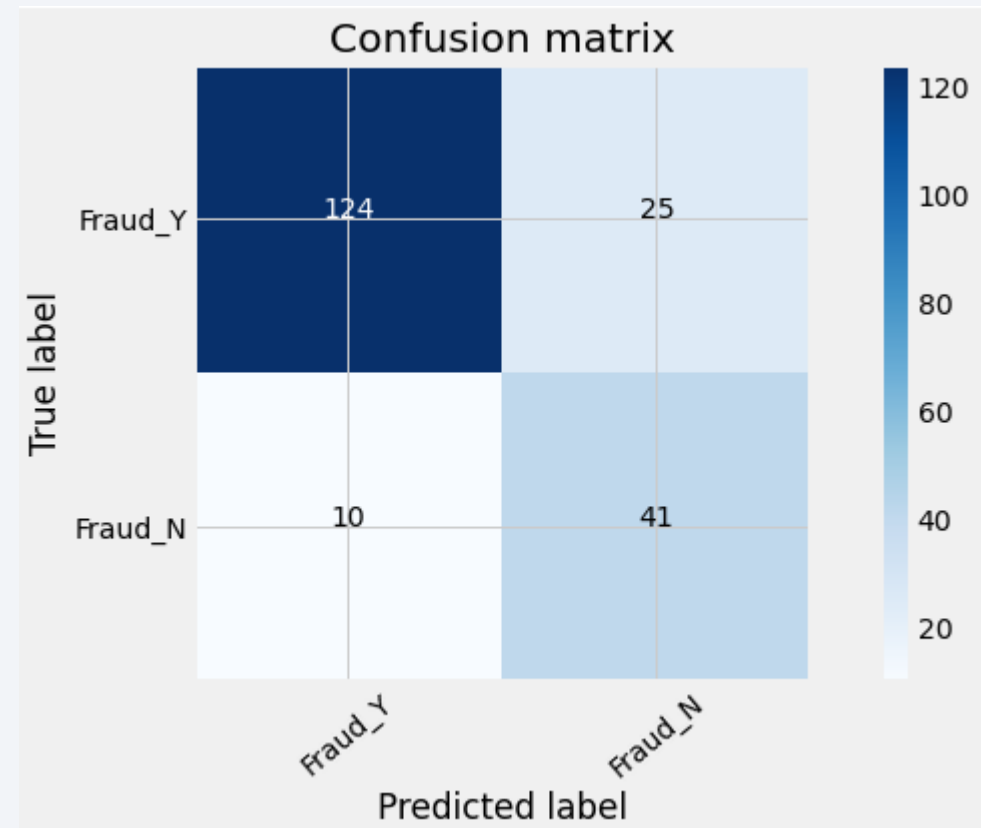
```
Accuracy: 82.5  
Cohen Kappa: 0.58  
Recall: 80.39
```

```
Classification Report:  
  
              precision    recall  f1-score   support  
  
      0           0.93       0.83       0.88         149  
      1           0.62       0.80       0.70          51  
  
   accuracy                   0.82         200  
  macro avg           0.77       0.82       0.79         200  
weighted avg           0.85       0.82       0.83         200  
  
0.836
```

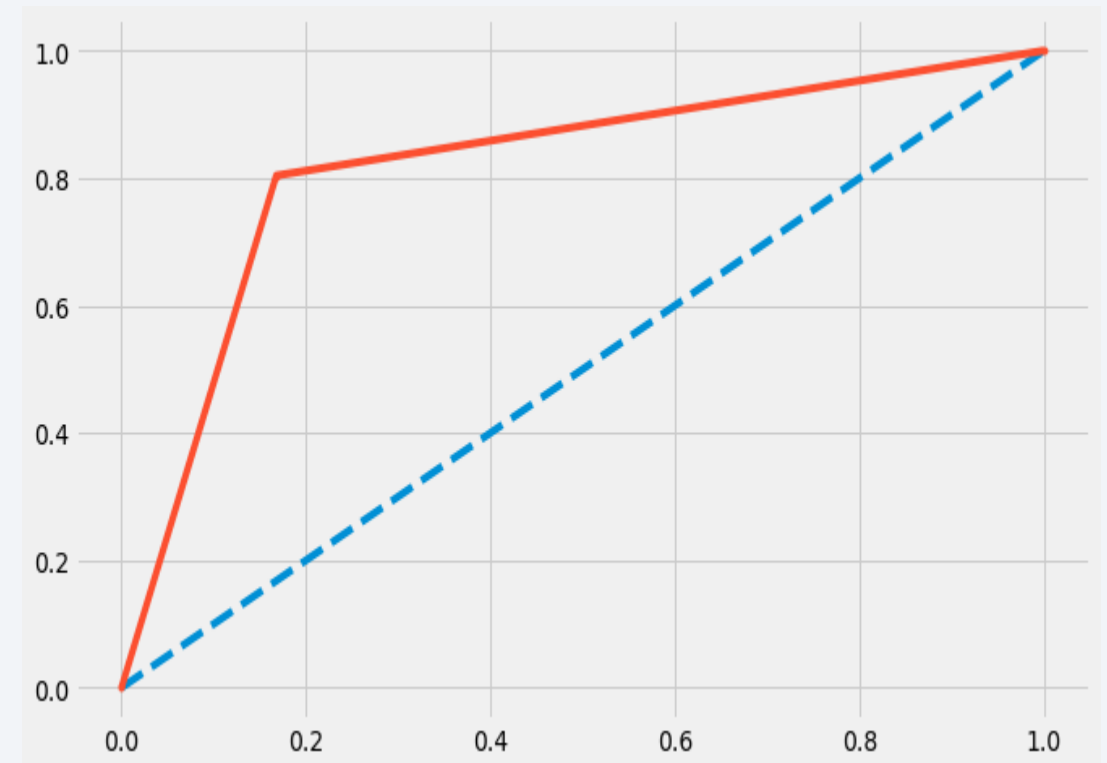
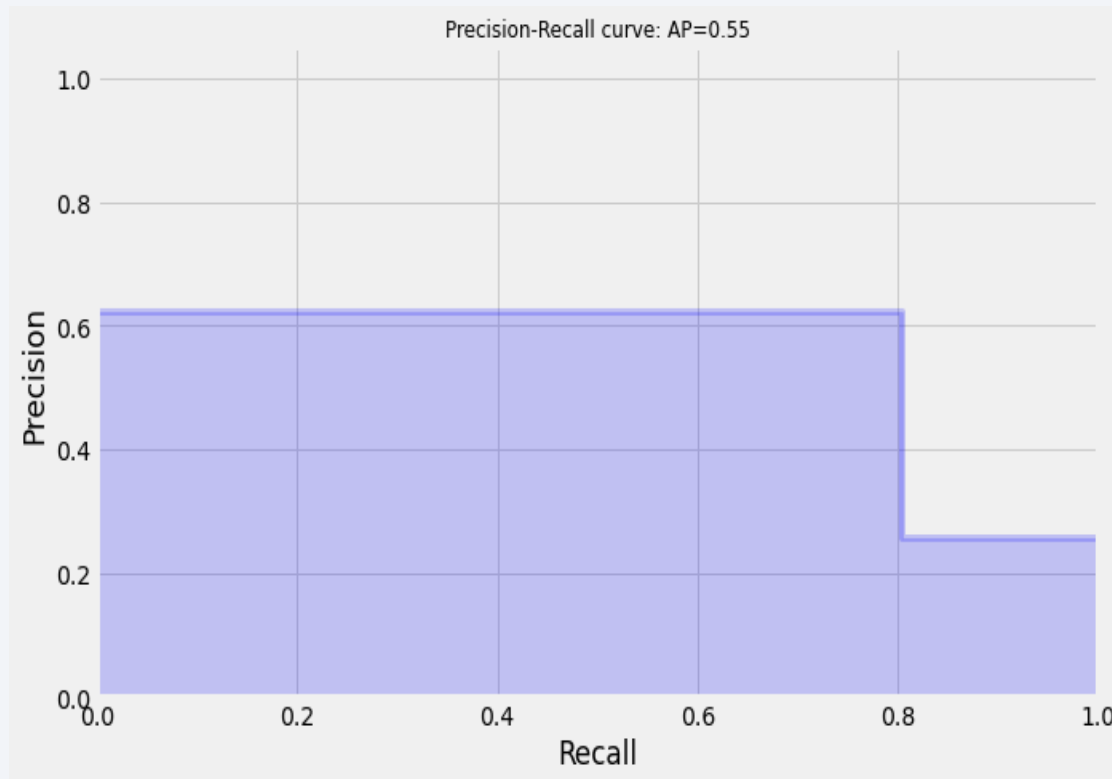
Confusion Matrix

- ✓ 124 transactions were classified as valid that were actually valid
- ✓ 10 transactions were classified as fraud that were actually valid (*type 1 error*)
- ✓ 25 transactions were classified as valid that were fraud (*type 2 error*)
- ✓ 41 transactions were classified as fraud that were actually fraud.
- ✓ $\text{Err} = \{(25+10) / (124+10+25+41)\} * 100 = 17.5\%$

Algorithm misclassified 17.5% fraudulent transactions.



Model Performance



The plot of the ROC Curve confirms the AUC interpretation of a skillful model for most probability thresholds.

Conclusions



- ✓ LR and LDA are good enough for both Feature Selection as well as Model Selection
- ✓ From Voting Classifier, Logistic Regression is best with the Accuracy Score 83%
- ✓ XGB Model provide the improved performance of 82.5% with fitted model

Appendix

- ✓ GitHub Repository URL:

https://github.com/veer2701/github_projects/blob/main/Advanced%20Data%20Science%20with%20IBM%20Specialization/INSURANCE%20FRAUD%20DETECTION%20USING%20MACHINE%20LEARNING-OK.ipynb

- ✓ Kaggle Dataset: “insurance_claims.csv”

- ✓ Instructors:

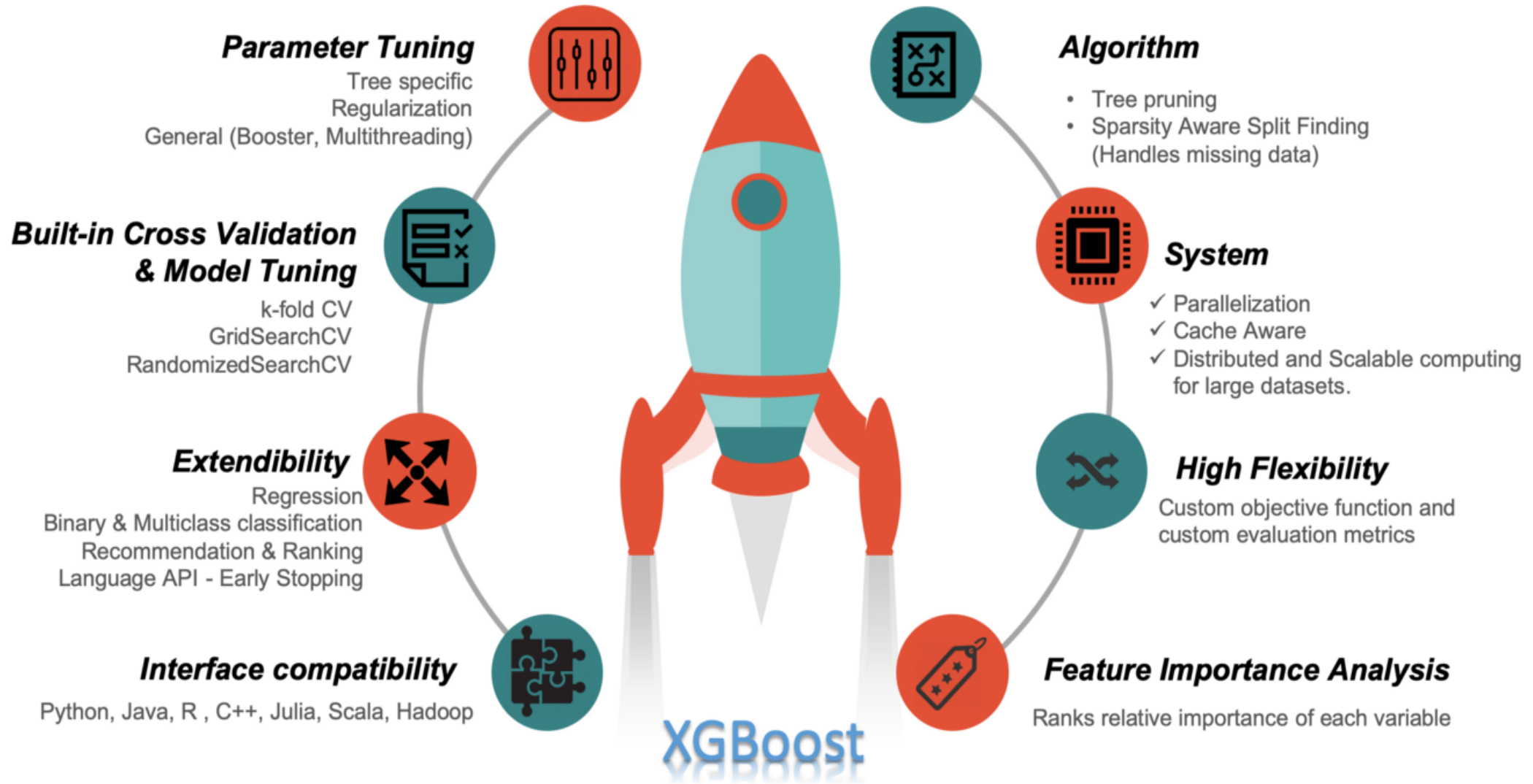
Romeo Kienzler, Niketan Pansare, Max Pumperla,

Nikolay Manchev, Tom Hanlon, Ilja Rasin

Appendix

- **References**
- [XGBClassifier](#)
- [Hyper-parameter Tuning](#)
- [SMOTE](#)
- [Getting started with XGBoost](#)
- [GridSearchCV & Optimisation:](#)
- **Book:** Python Machine Learning by Sebastian Raschka and Vahid Mirjalili
- **Book:** An introduction to variable and feature selection by Isabelle Guyon

Appendix



Thank You