
Parking Tickets in Chicago

— Predicting Payment —

Overview

- Data from [ProPublica](#)
 - City of Chicago Parking Tickets
 - Passenger Vehicles only
 - Multiple decades and has over 50 million observations
 - Only analyzing first million
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- Potential to help allocate city resources/increase revenue

Data

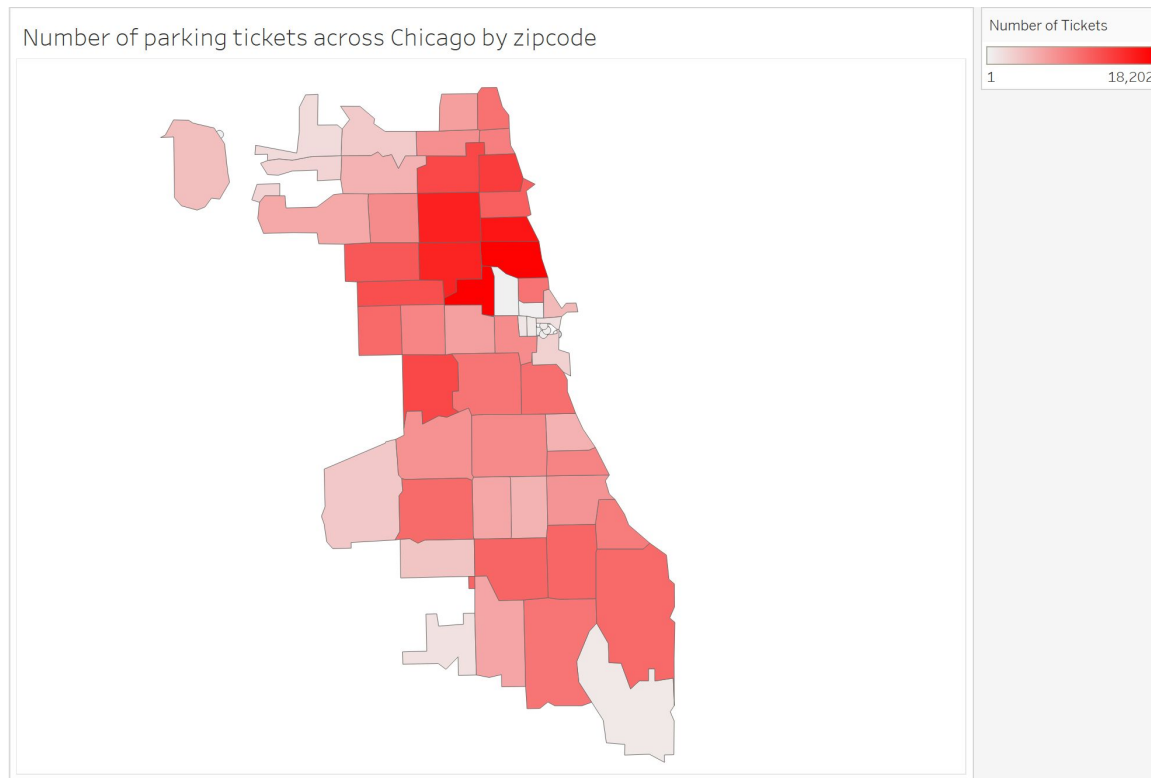
Target: Payment Status

- Paid if paid
- Not Paid if: Dismissed, Unpaid, Hearing Required, Notice Sent, or Bankruptcy

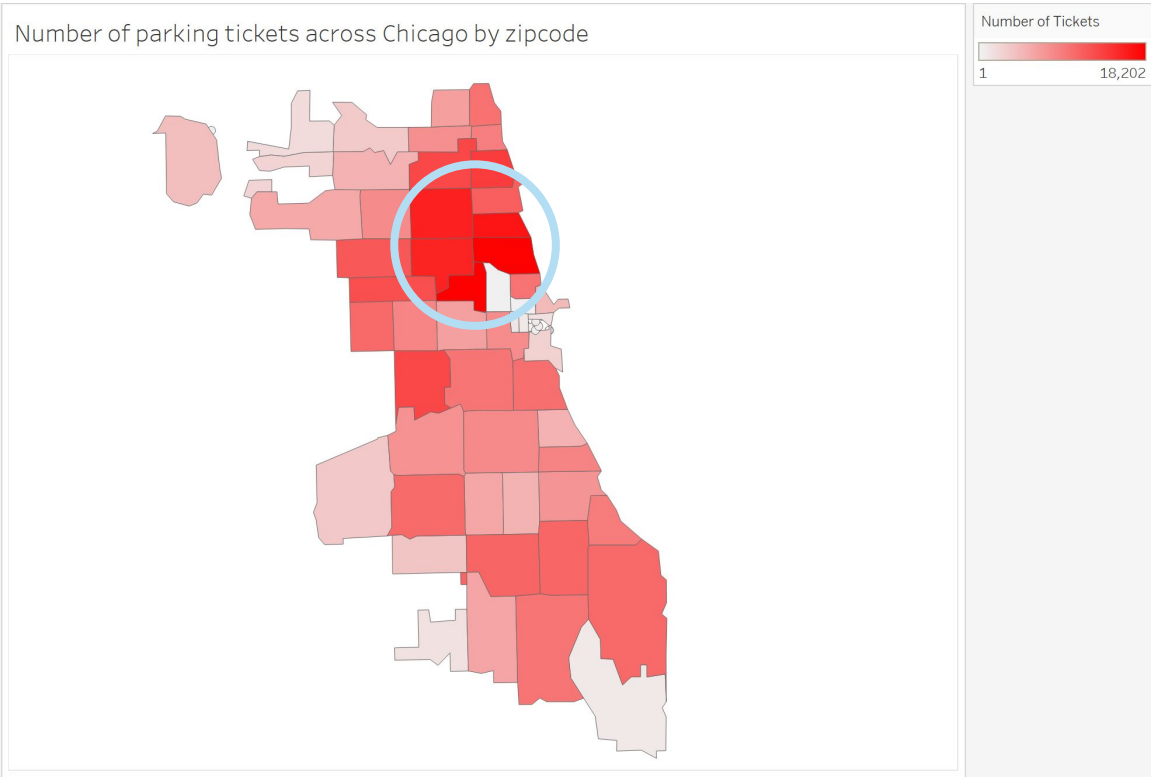
Features for Focus

- License Plate State
- Geolocation (Latitude/Longitude)
- Fine amount (\$\$\$)
- Violation code (what is the ticket for?)
- Count of license plate appearing in data

EDA

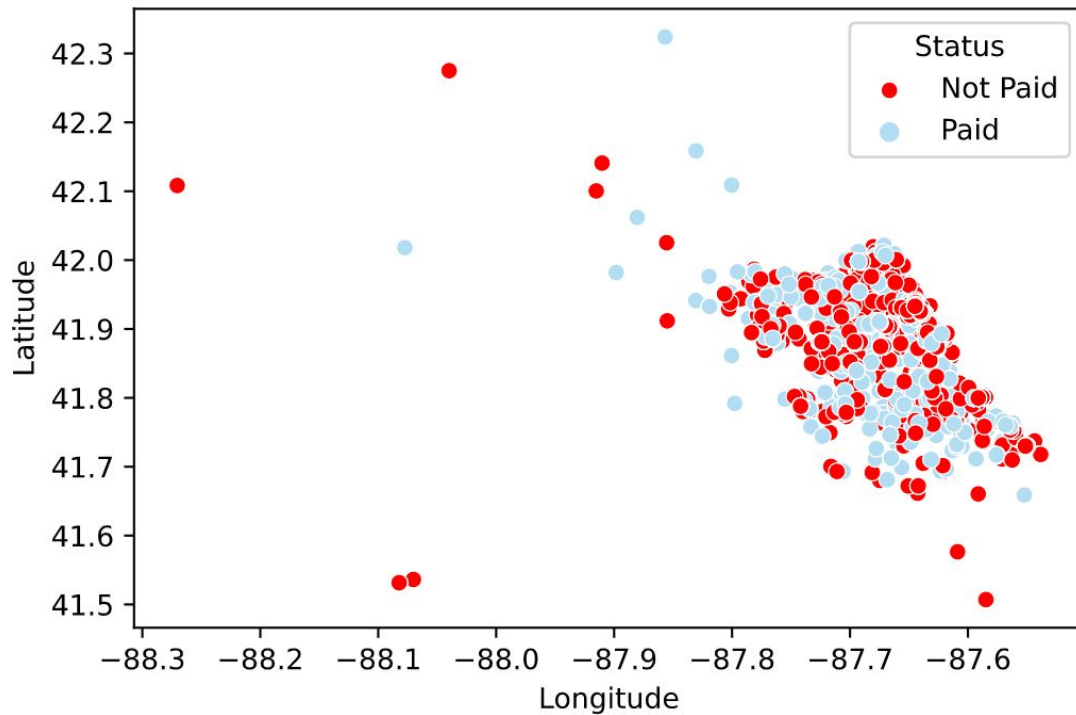


EDA



EDA

On a citywide scale, not a great deal of separability



Thoughts on classifying and potential errors

Imbalance of paid tickets to unpaid (two to one): Random Oversample Unpaid

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Goal: To separate paid and unpaid tickets as cleanly as possible

Metric: Use AUC score and confirm with confusion matrix

Baselining

- Simple Logistic models based on each feature for smaller data sample
 - AUC scores near 50%, not much better than coin flip
- Simple kNN models similar to above
 - Performance (speed) is terrible on larger data sets, not worth waiting
- Use more features in training logistic, Random Forest, and XGBoost

The top performing models were

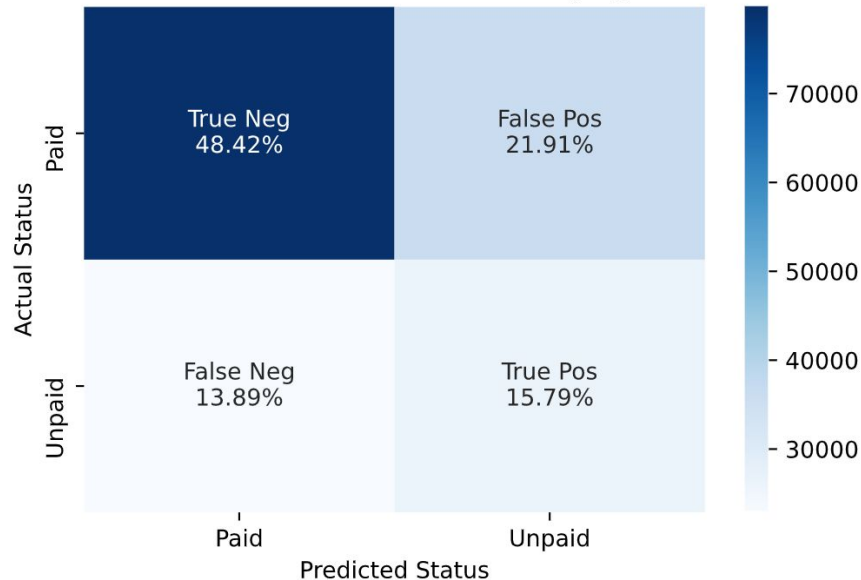
- 1) XGBoost**
- 2) Random Forest**

XGBoost and Random Forest similar on unseen data

How well is the XGBoost model classifying ticket status?

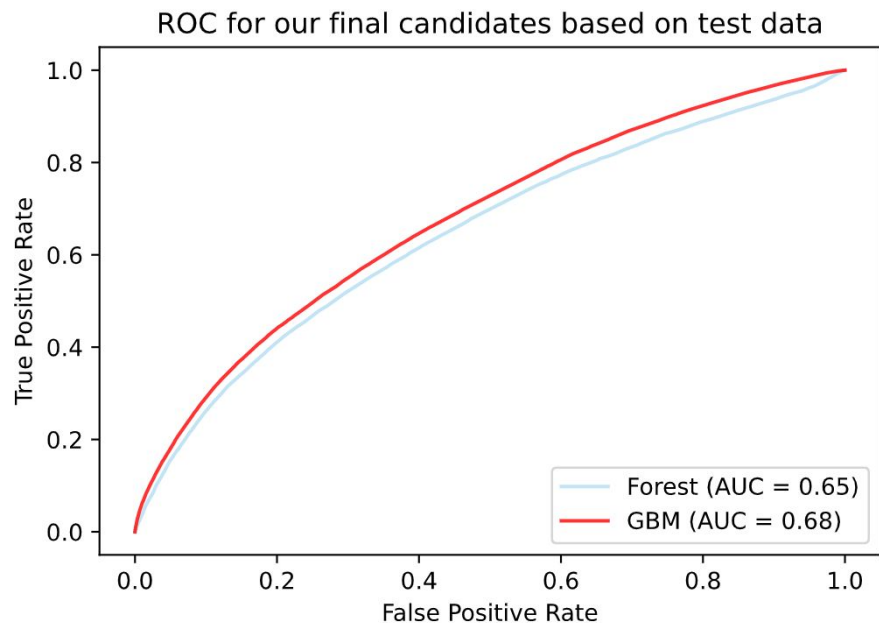


How well is the random forest model classifying ticket status?



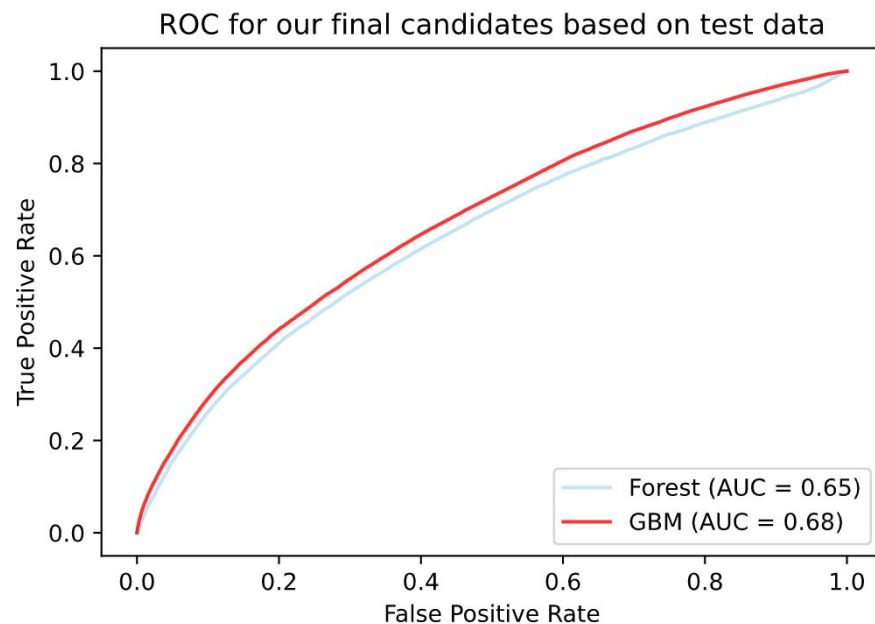
XGBoost generally outperforms Random Forest

Score	Random Forest	XGBoost
AUC	.65	.68



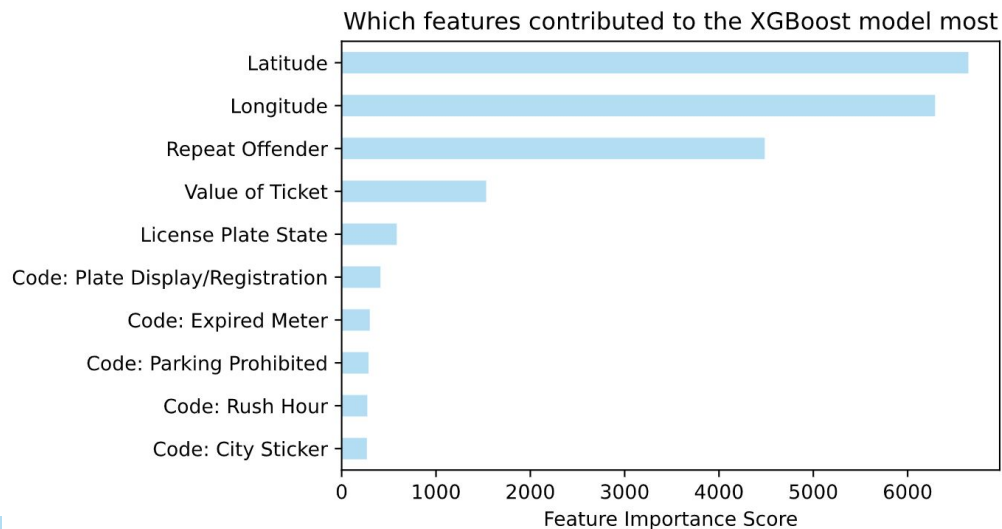
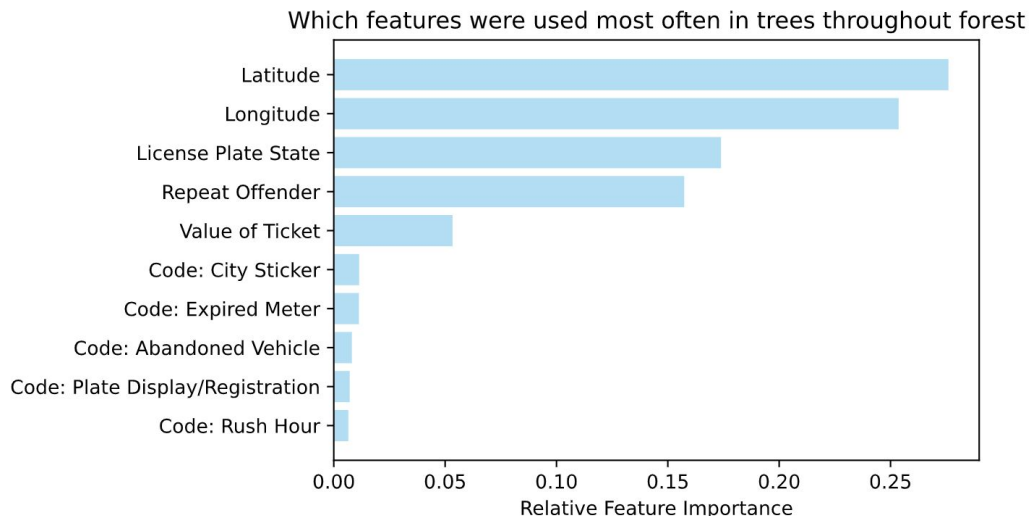
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Score	Random Forest	XGBoost
AUC	.65	.68
Accuracy	.64	.64
Recall	.53	.58
Precision	.42	.43
F1	.47	.49



Feature Importance

- General agreement across models
- Ticket location used most
- Many violations, importance spread disaggregated



Future Work

Use cloud computing to handle full dataset

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Rather than paid or not paid, dig deeper:

Given these features, predicting if ticket goes to court

Given ticket goes to court court cases, predicting judgements

Given these features, predicting car seizure

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Create additional model(s) for red light ticket data

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Create an applet to allow for ticket info to be entered and output a prediction

Potential Applications

Predict whether a given parking ticket will be paid or not paid

- A) Since tickets are only written if infractions are found, the city must decide how to allocate employees. To generate more revenue, identify areas and tickets more likely to yield payment.

- B) Since tickets are intended to be consequences, the city should be looking to monitor its citizens fairly, so no change should occur to ticket writing. However, it would be useful to know if the city could flag a ticket as being more likely to be delinquent and need following up.

Thank you!

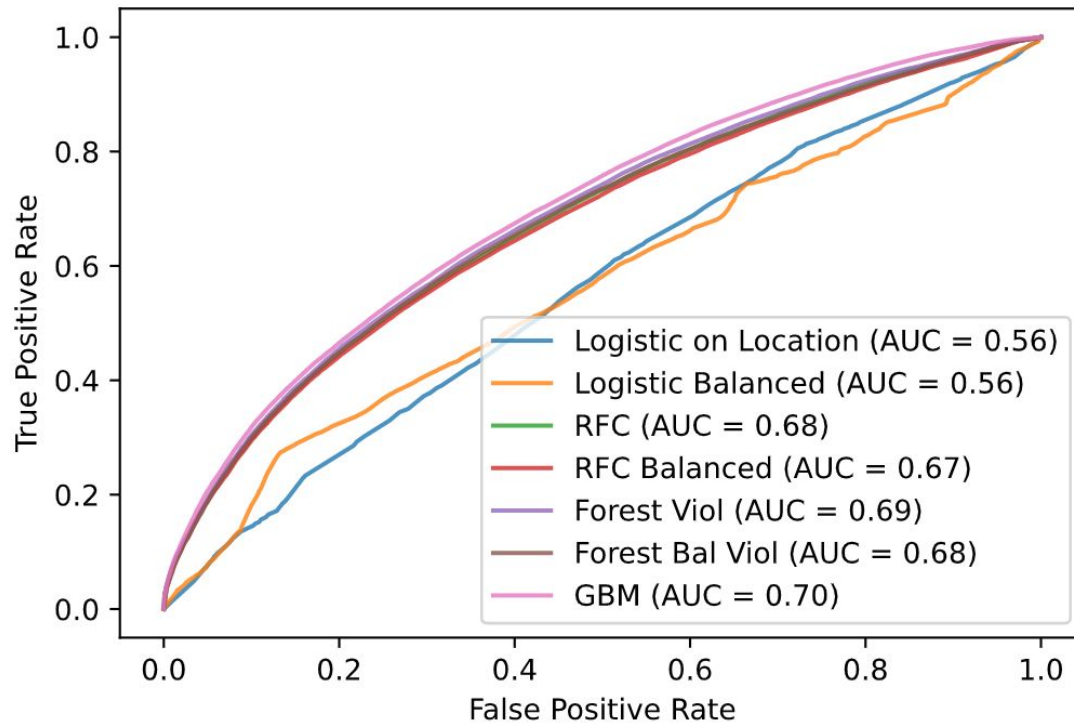
Questions?

Appendix

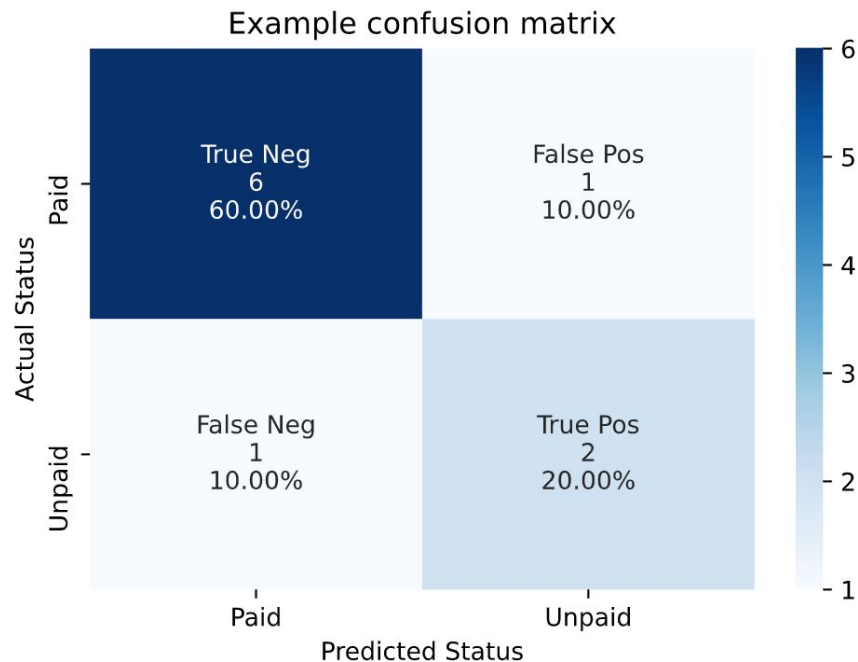
Potential Features

Ticket Number	Issue Date	Norm Address
Violation Location	License Plate Code	Year
License Plate State	License Plate Type	Month
Zip code	Violation Code	Hour
Violation Description	Unit	Warm
Unit Description	Vehicle Make	Tract ID
Fine Level 1	Fine Level 2	Community Area #
Current Amount Due	Total Payments	Community Area Name
Ticket Queue (Status)	Ticket Queue Date	Geocoded Address
Notice Level	Notice Number	Geocode Latitude
Hearing Disposition	Officer	Geocode Longitude

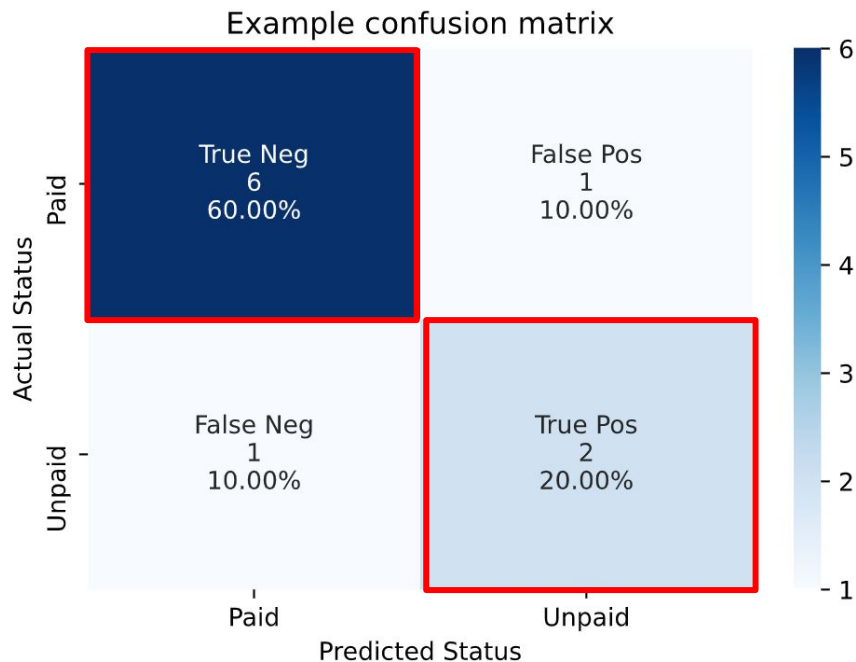
ROC Comparison (On Validation Data)



Confusion Matrix Explanation

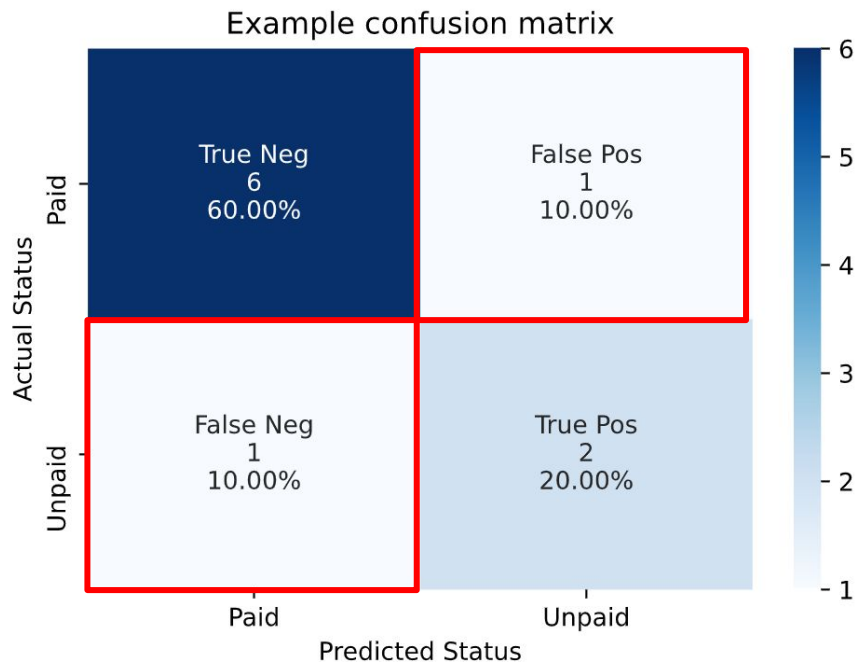


Confusion Matrix Explanation



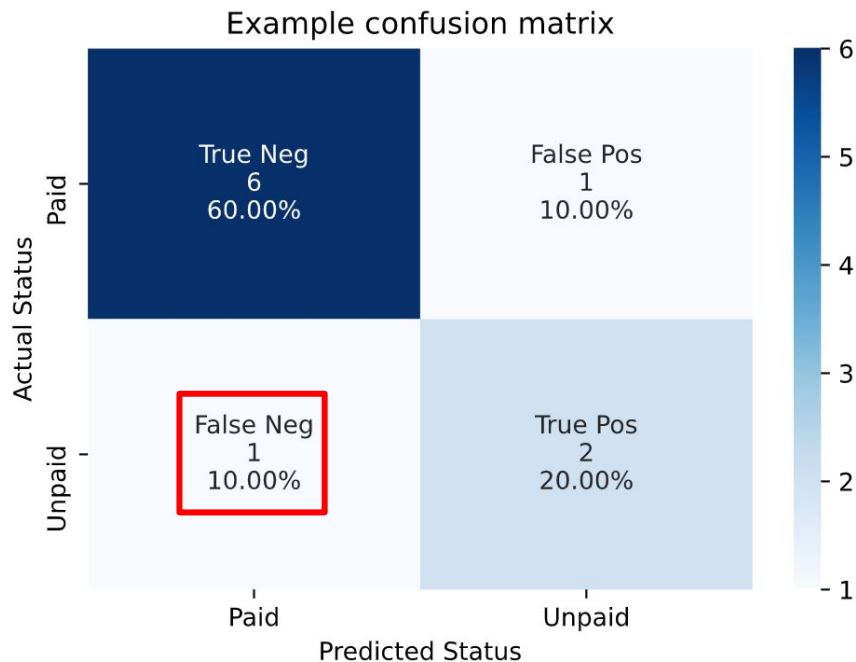
- Correct predictions on the main diagonal

Confusion Matrix Explanation



- Correct predictions on the main diagonal
- False Positives and Negatives shown on the other diagonal

Confusion Matrix Explanation



- Correct predictions on the main diagonal
- False Positives and Negatives shown on the other diagonal
- Displays number classified and percentage of the total