E-Commerce Shipment On-Time Delivery

Agenda

01 Business Problem

02 Exploratory Data Analysis

03 Predictive Modeling

04 Conclusions

05 Recommendation

06 Next Steps

01 Business Problem

The company has experienced decline in customer satisfaction at one of its major distribution centers due to excessive late deliveries.

We are charged with:

- Analyze the shipping data to find root cause of lateness.
- Create a model to predict if a shipment will be late, so that the company can preemptively take corrective action.

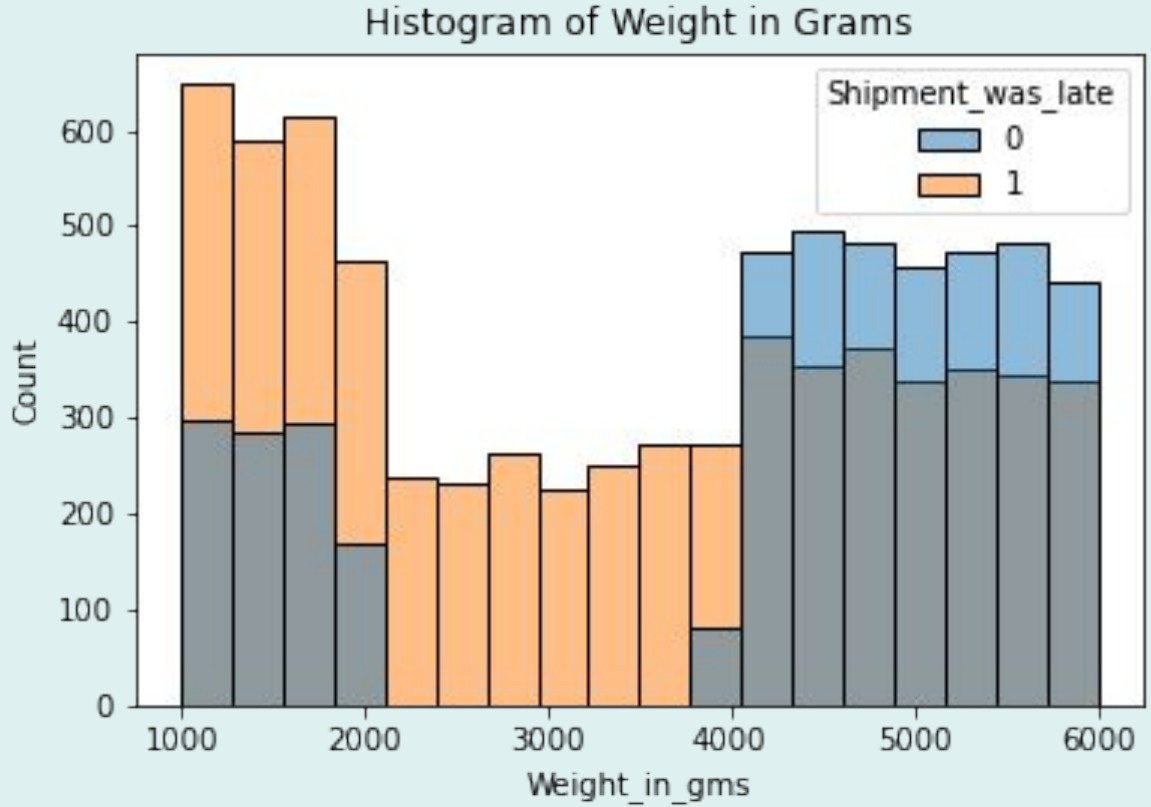
02 Data Analysis

The dataset used in this analysis contained records of 11,000 shipments, including details regarding:

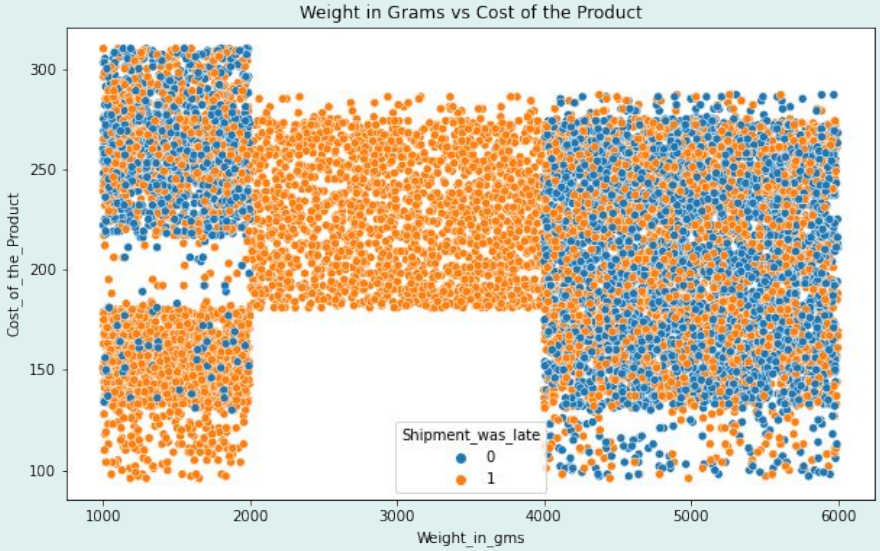
- Warehouse block
- Mode of shipment
- Customer care calls
- Customer rating
- Cost of the product
- Prior purchases
- Product importance
- Gender
- Discount offered
- Weight
- **Was the shipment late?**

Source: E-Commerce Shipping Data (kaggle.com)

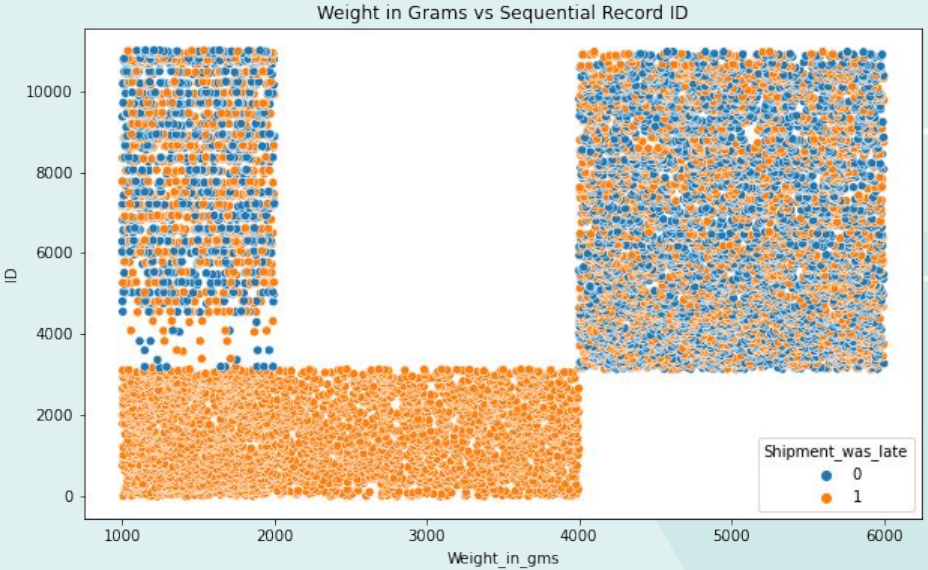
Problems with the Data: Shipment Weight



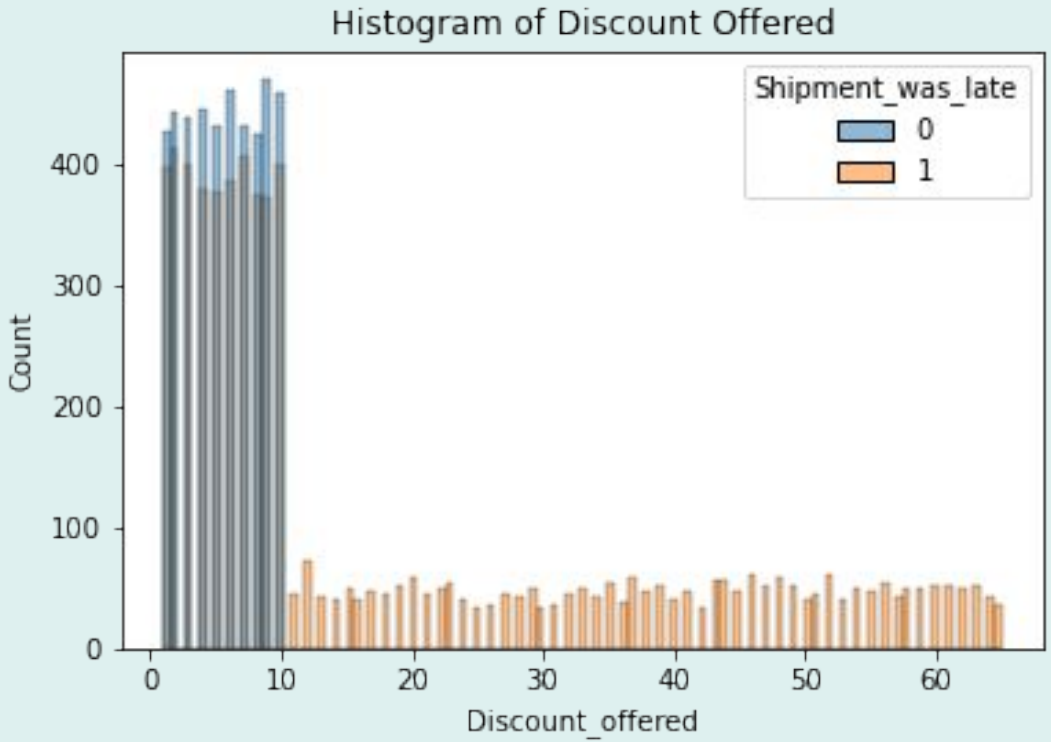
Problems with the Data: Shipment Weight



- Strange segmentation in scatterplots
- Further investigation is required



Problems with the Data: Discount Offered

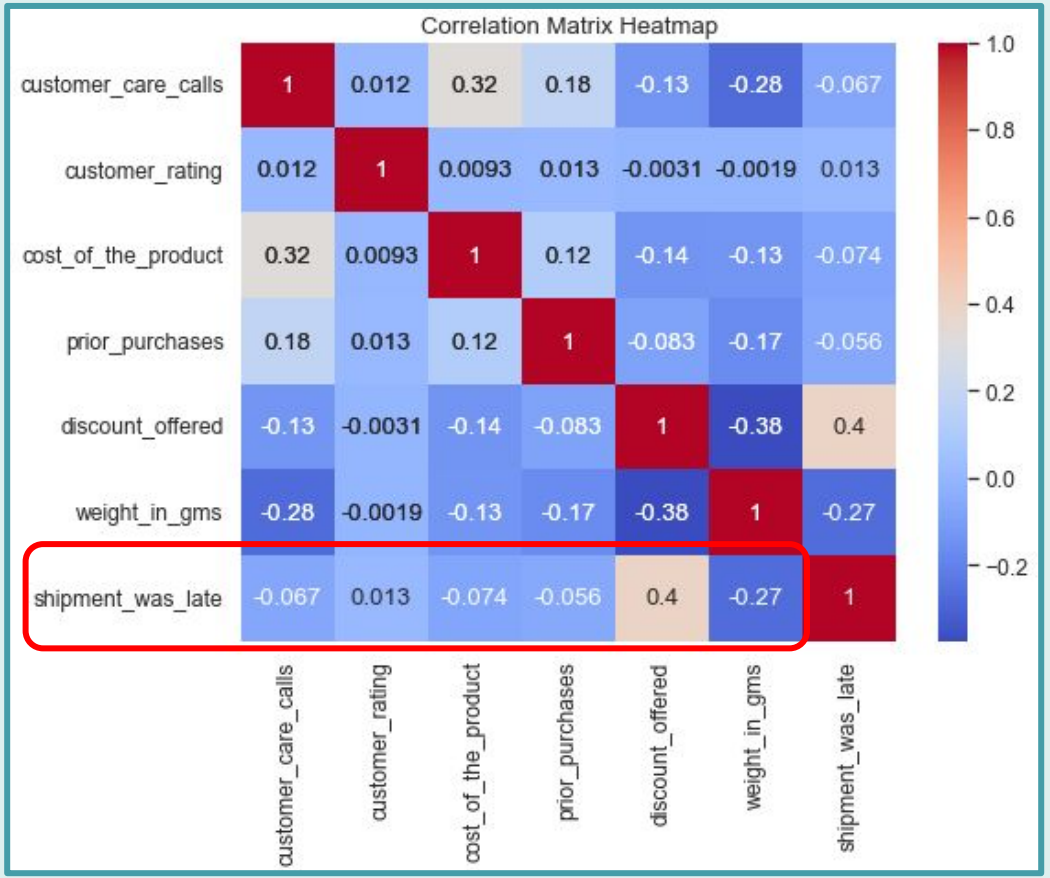


Leading Theory:
A discount of more than $10 is only offered if a shipment is late.

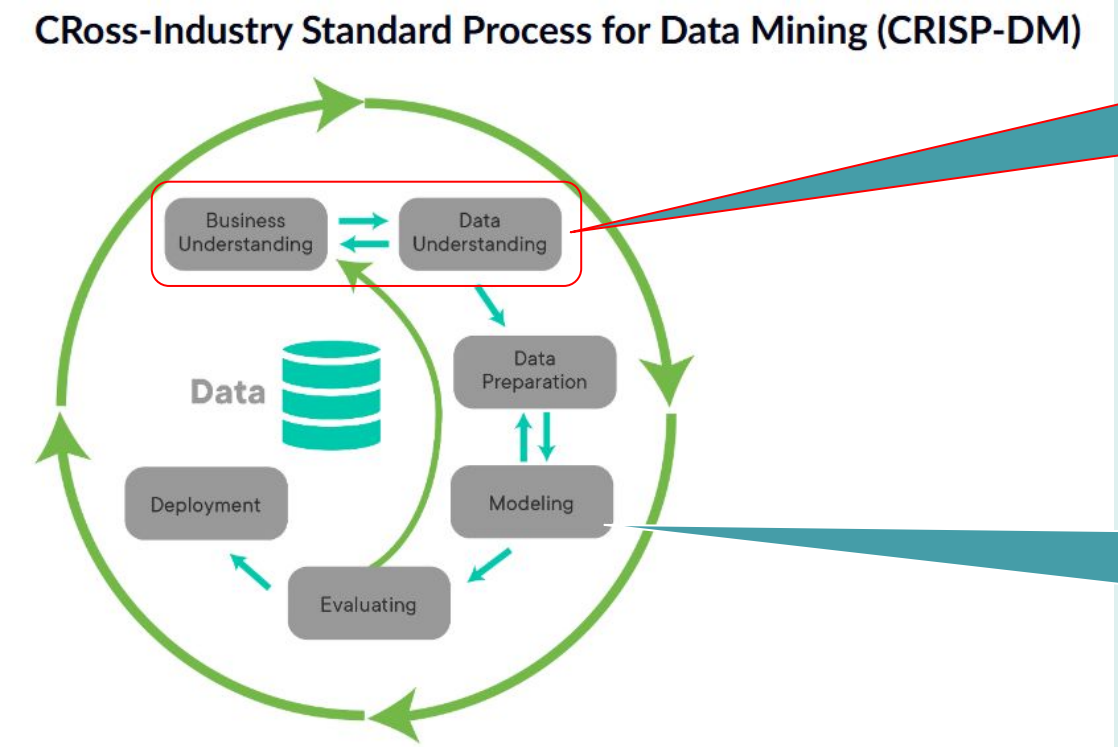
If true, **we cannot use Discount_offered** as a predictor of whether a shipment will be late!

further investigation is required.

Problems with the Data: Little Correlation



Where We Are



Due to unanswered questions about the data, we are still here

However, we can offer preliminary stop-gap predictive models

03 Predictive Modeling

Business Goal: **Predict if a shipment will be late**

Possible prediction outcomes:

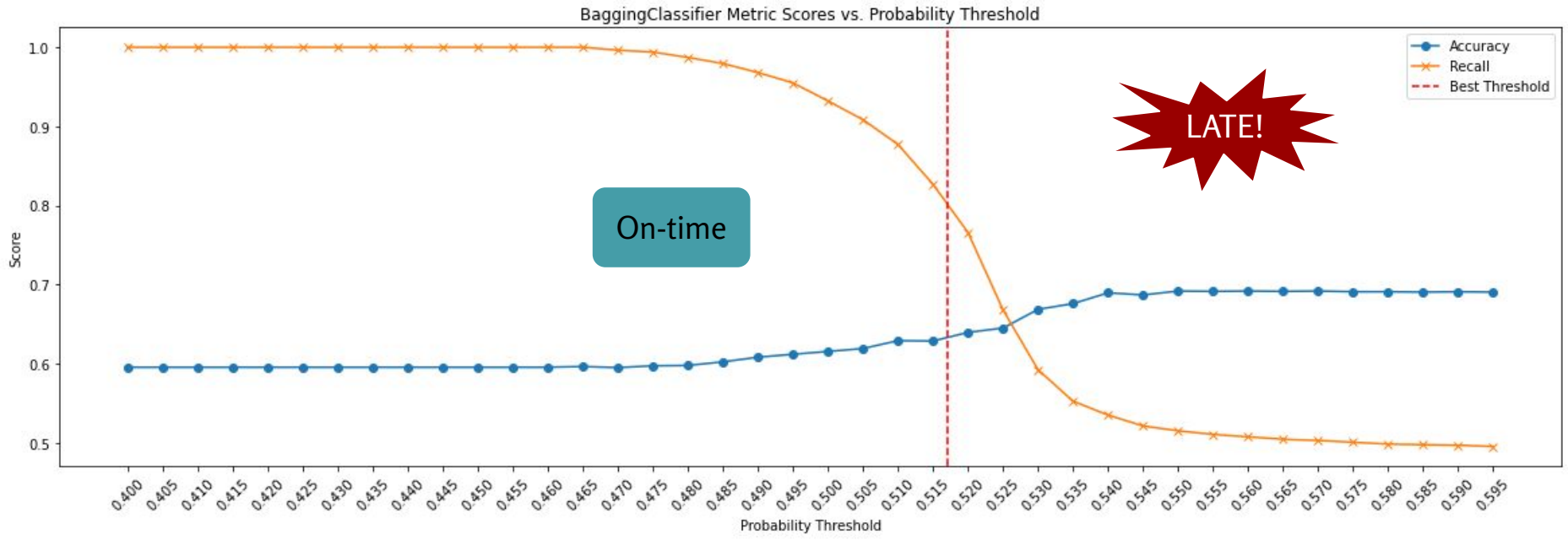
- We correctly predict a shipment will be late (True Positive)
- We correctly predict a shipment will be on-time (True Negative)

- We **incorrectly** predict a shipment will be late (False Positive)
- We **incorrectly** predict a shipment will be on-time (False Negative)

BAD!!!

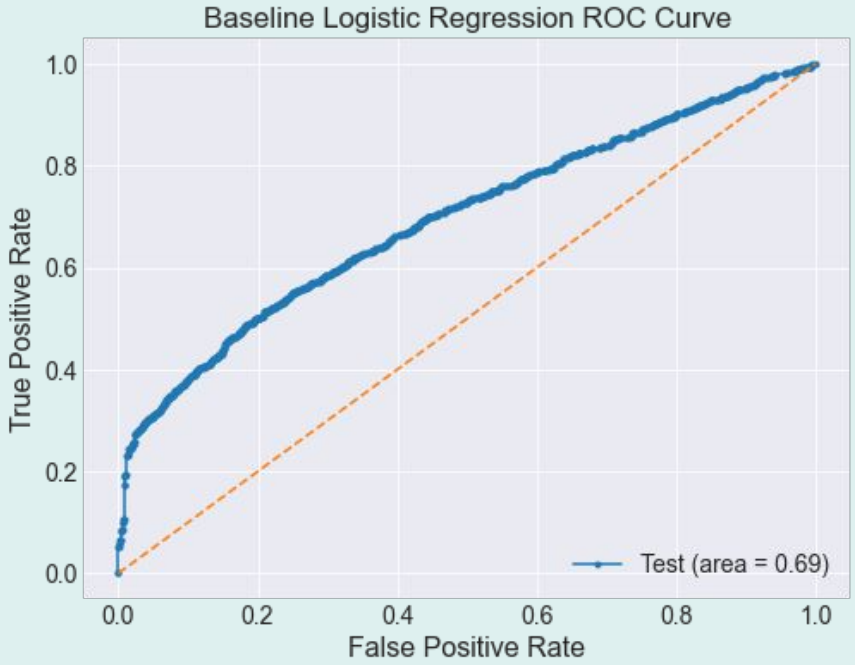
Model Tuning Methodology

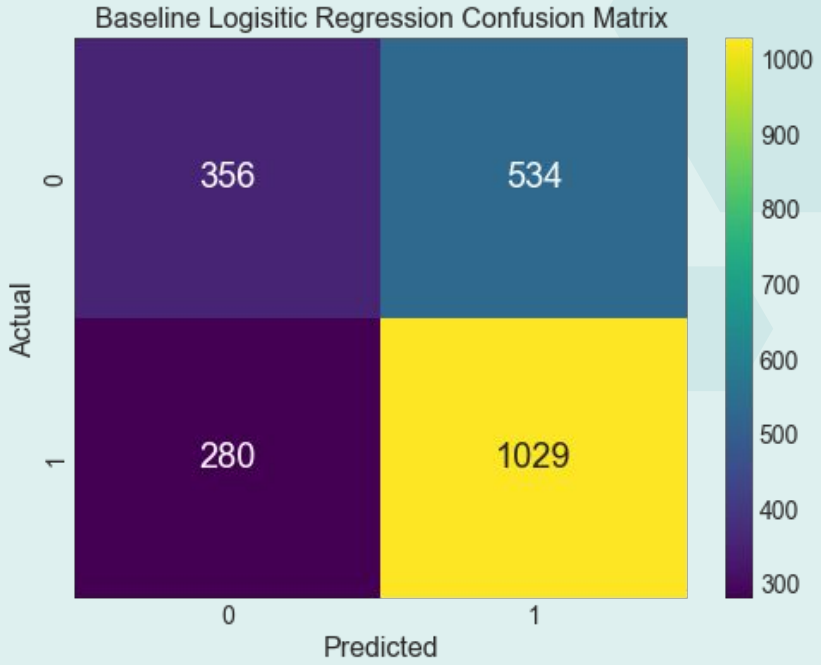
- Feature Selection, outlier removal
- Key hyperparameter grid search with 5-fold cross-validation
- Probability threshold tuning of the final model



Logistic Regression Baseline Model

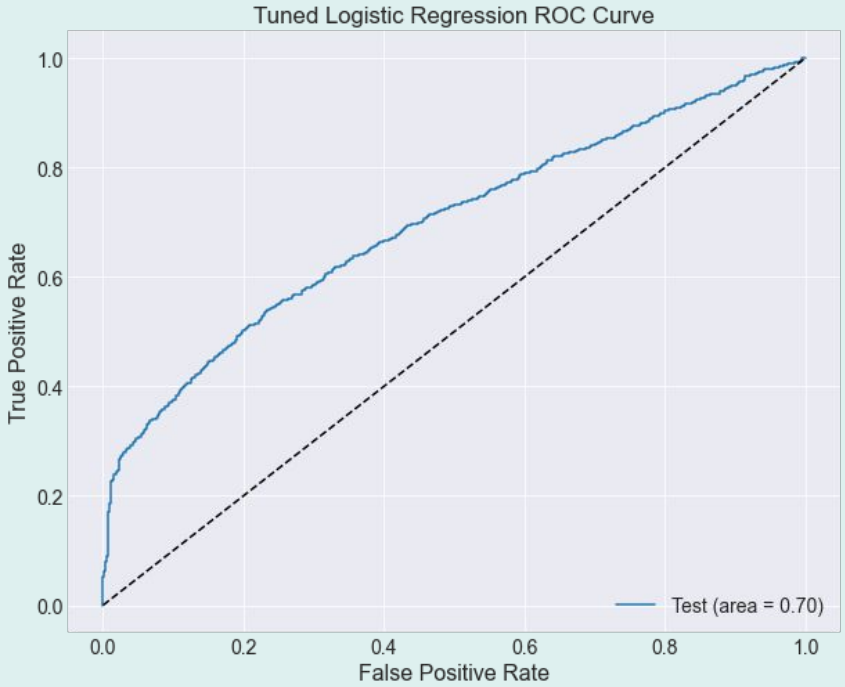
Precision	F1	Accuracy	Recall
0.63	0.72	0.63	0.79





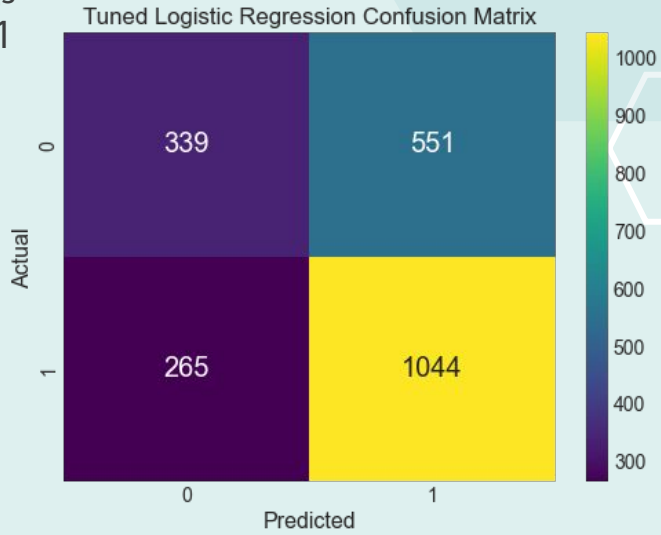
Logistic Regression Hyperparameter Tuned

Precision	F1	Accuracy	Recall
0.65	0.72	0.63	0.80



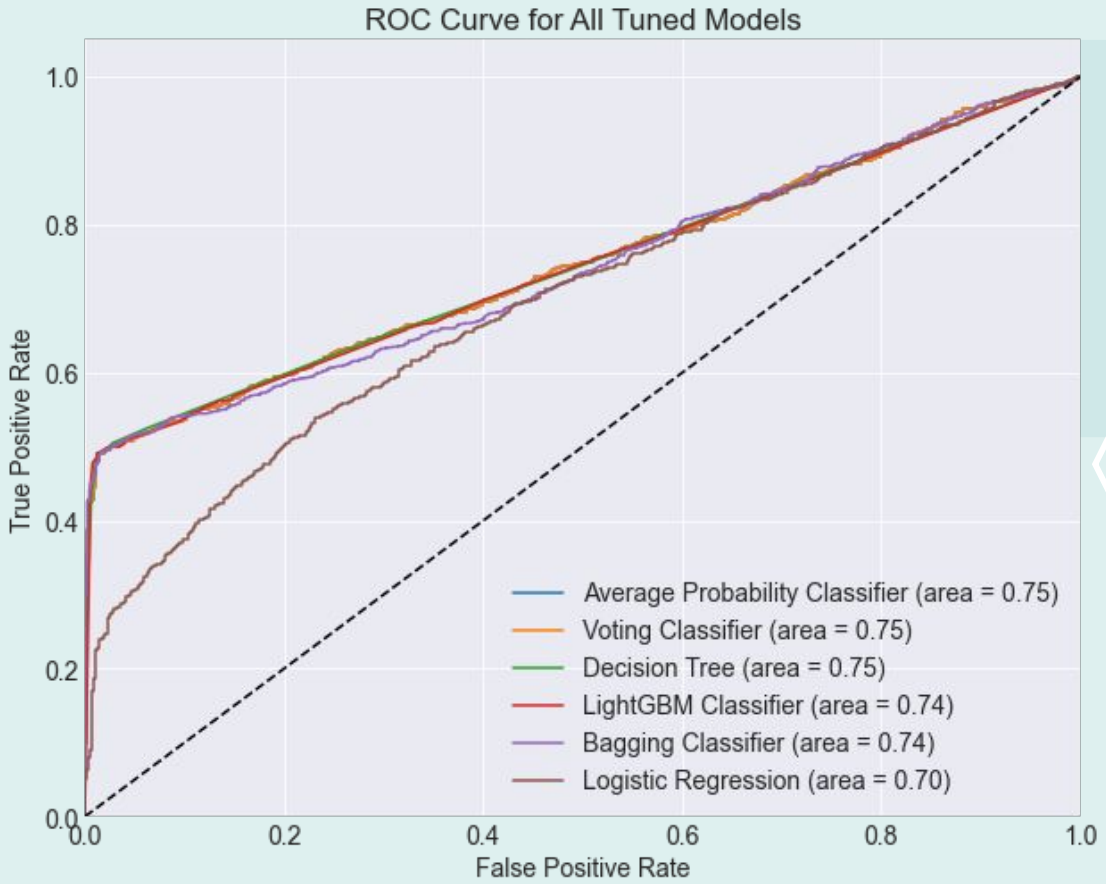
Best Hyperparameters:

- GridSearch: (CV: 5, Scoring: Recall)
- C: 0.01
- Class_weight: None
- Max_iter: 100
- Penalty: l2
- Solver: lbfgs
- Tol: 0.0001

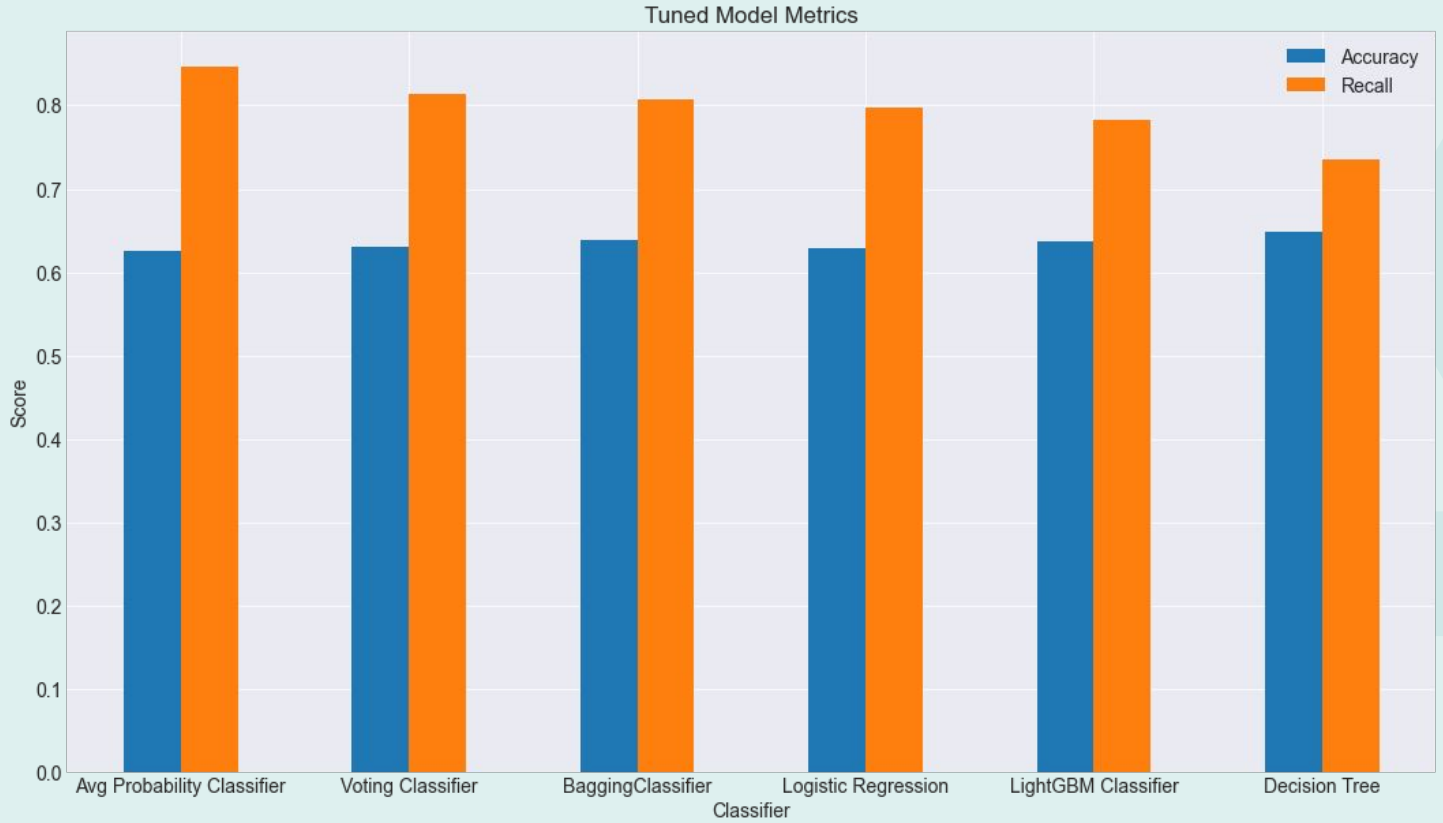


Performance of All Models

Classifier Models
Average Probability Classifier
Voting Classifier
Bagging Classifier
Logistic Regression
LightGBM Classifier
Decision Tree



All Tuned Models Final Scoring



Model Selected: Average Probability Classifier

04 Conclusion

Best Model: Average Probability Classifier

- Highest Primary Metric: Recall
- Accuracy was not the highest, but comparable to other models
- Combines predictions from multiple models

Final Metrics:

Precision	F1	Accuracy	Recall
0.64	0.73	0.63	0.85

05 Recommendation

1. Back to square 1: Business Understanding <-> Data Understanding
2. Improve data acquisition methods to increase performance of future models
3. Implement the ***Average Probability Classification*** model as a stop-gap to avoid late shipments until items 1 and 2 can be addressed

Final Metrics:

Precision	F1	Accuracy	Recall
0.64	0.73	0.63	0.85

06 Next Steps

1. Prioritize focus on **Business/Data Understanding**; answer:
    - Are discounts offered over $10 due to prior knowledge lateness?
    - Root cause(s) for segmentation in shipment weight data
    - Root cause(s) for segmentation in ID… is the data time sequential?
2. Investigate improving data acquisition:
    - What data can we gather that will help us better predict lateness?
3. Deployment of ***Average Probability Classification***, predict late shipments:
    - Flag potential late shipments for expediting delivery
    - If lateness cannot be corrected, preemptively engage with customer to inform, offer discount, etc.

Thanks!

Do you have any questions?

Dale DeFord
daledeford@gmail.com

Brian Woo
brianhwwoo@gmail.com