Will the Falcon 9 Succeed?

Richmond Ballesteros

October 18, 2023

INTRODUCTION

- Executive Summary
- Methodology
- Results
- Discussion
- Conclusion
- Appendix

EXECUTIVE SUMMARY

- Need to predict if first stage of Falcon 9, SpaceX will successfully land
  - Potentially be marginally cheaper launch than rival companies
- If successful, able to determine cost of entire launch
  - Information could be used if alternate company wants to bid against SpaceX for a rocket launch

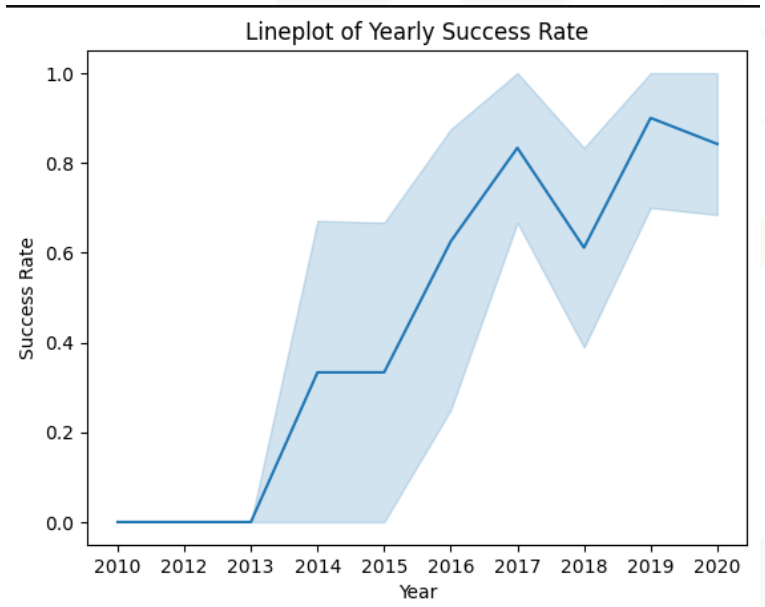
EXPLORATORY DATA ANALYSIS

Booster_Version	PAYLOAD_MASS__KG_
F9 B5 B1048.4	15600
F9 B5 B1049.4	15600
F9 B5 B1051.3	15600
F9 B5 B1056.4	15600
F9 B5 B1048.5	15600
F9 B5 B1051.4	15600
F9 B5 B1049.5	15600
F9 B5 B1060.2	15600
F9 B5 B1058.3	15600
F9 B5 B1051.6	15600
F9 B5 B1060.3	15600
F9 B5 B1049.7	15600

- SQL Querying
  - We learned that even with the maximum payload, there are many landing successes for certain booster versions
  - In addition, we learned that there are more failed mission outcomes than successful mission outcomes

Total Number of Successful Mission Outcomes	Total Number of Failed Mission Outcomes
98	101

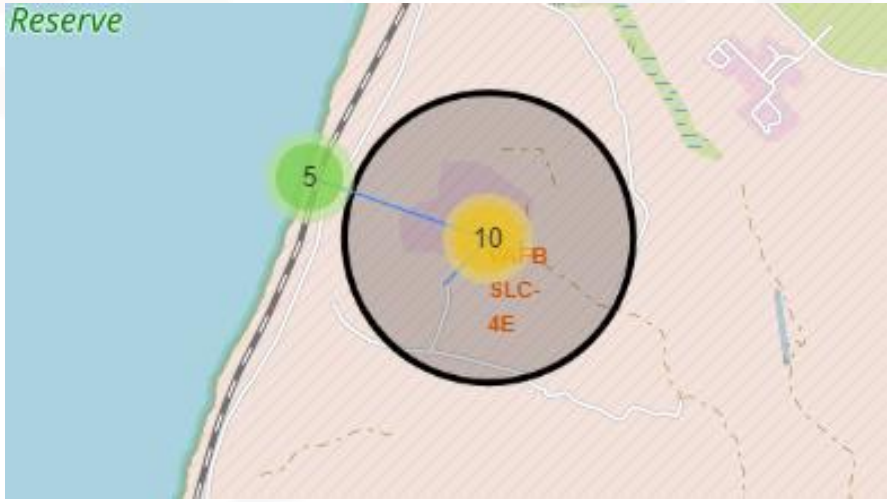
EXPLORATORY DATA ANALYSIS



- Seaborn Plots
  - We found that the year of the launch is proportional to the yearly success rate, meaning that launches are getting better
  - However, for other variables such as Launch Site and Booster Version, the success depended for each variable

EXPLORATORY DATA ANALYSIS

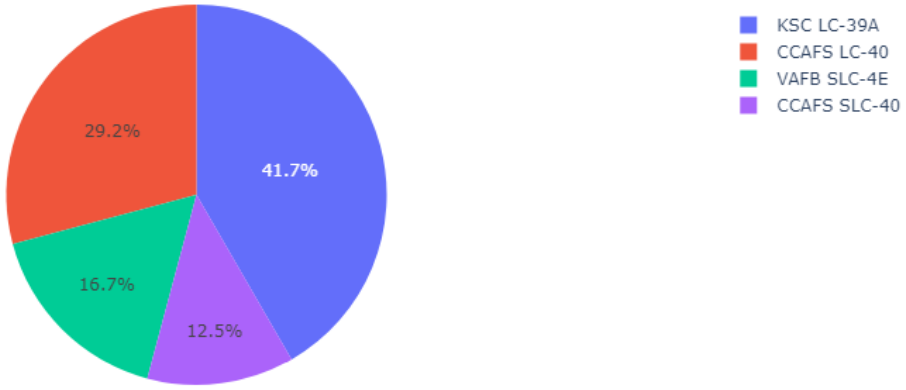
- Folium GeoMaps
  - We found that most launch sites are near roads and the coastlines but fairly far from cities



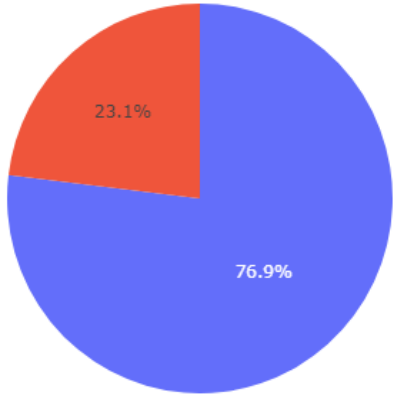
EXPLORATORY DATA ANALYSIS

- Dash application
  - We found that the launch site KSC LC-39A is the launch site with the most successful landings
  - 41.7% of all successful launches were from KSC LC-39A
  - KSC LC-39A has an almost 77% successful launch rate

Total Success Launches by Site

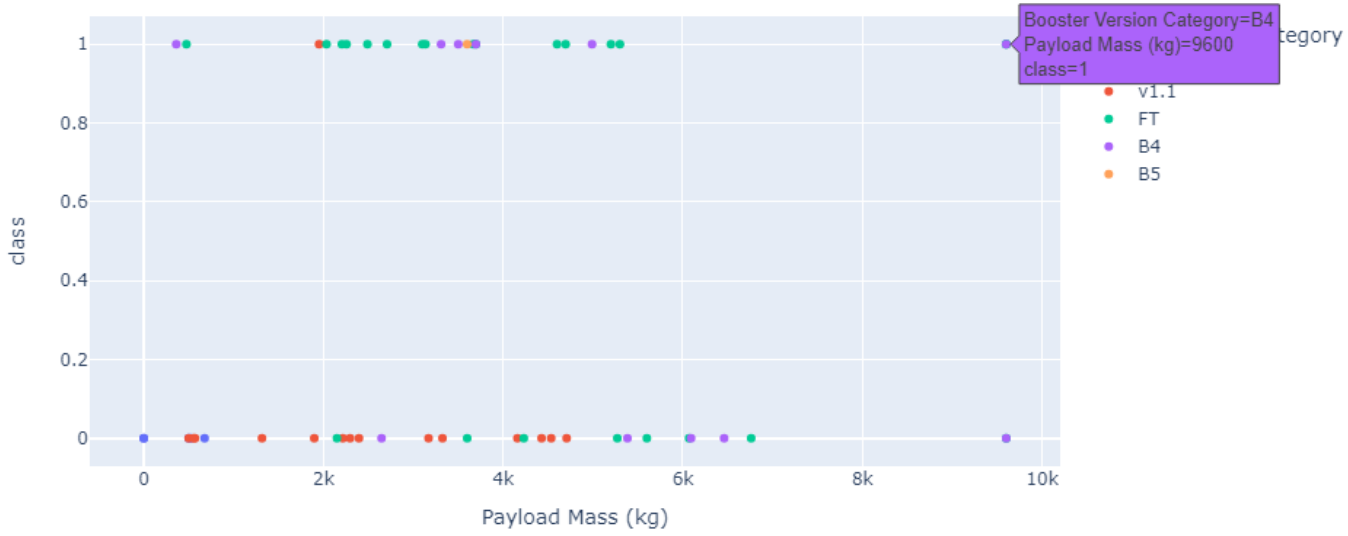


Total Success Launches for site KSC LC-39A

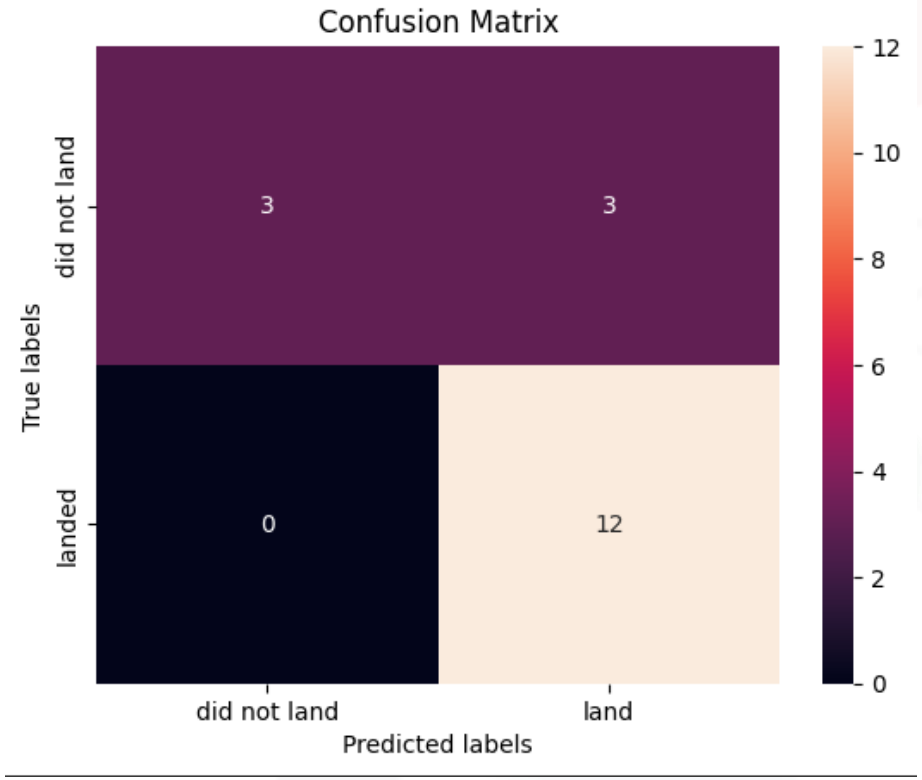


EXPLORATORY DATA ANALYSIS

- Dash application
  - We also found that the successful landing with the heaviest payload mass was 9600 kg and was Booster Version B4



RESULTS



- Predictive Model
  - We found that the Decision Tree model was the best for predicting whether or not the first launch would be successful
  - Training score: 0.83334
  - Best score: 0.903
  - Best parameters: shown below

```
0.8333333333333334
```

```
tuned hpyerparameters :(best parameters)  {'criterion': 'gini', 'max_depth': 4, 'max_features': 'sqrt', 'min_samples_leaf': 1, 'min_samples_split': 5, 'splitter': 'random'}
accuracy : 0.9035714285714287
```

CONCLUSION

- Best Model: Decision Tree
- Launches in general have gotten better over the years
  - Launch Site KSC LC-39A has the best successful launch rate as well as the highest number of successful launches of all launch sites
  - Highest successful launch payload mass is 9600 kg with booster version 4B