Space-X First Stage Reuse Rate

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EXECUTIVE SUMMARY

- Important Cases of A Larger Success Margin
  - Payload between 2500 and 4000 kg
  - KSC LC-39A Launch Site with a 76.9% Success Rate
  - Time: as SpaceX has aged it has improved its chances dramatically, the first three years saw no success.
- The Booster Type May Play A Role In Success
- Two Major Keys To Cost Savings.
  - Land Transportation i.e. Train or Highway
  - Near Sea, presumably to reacquire wreckage and or a successfully landed rocket.
- Distance From Cities is not close

INTRODUCTION

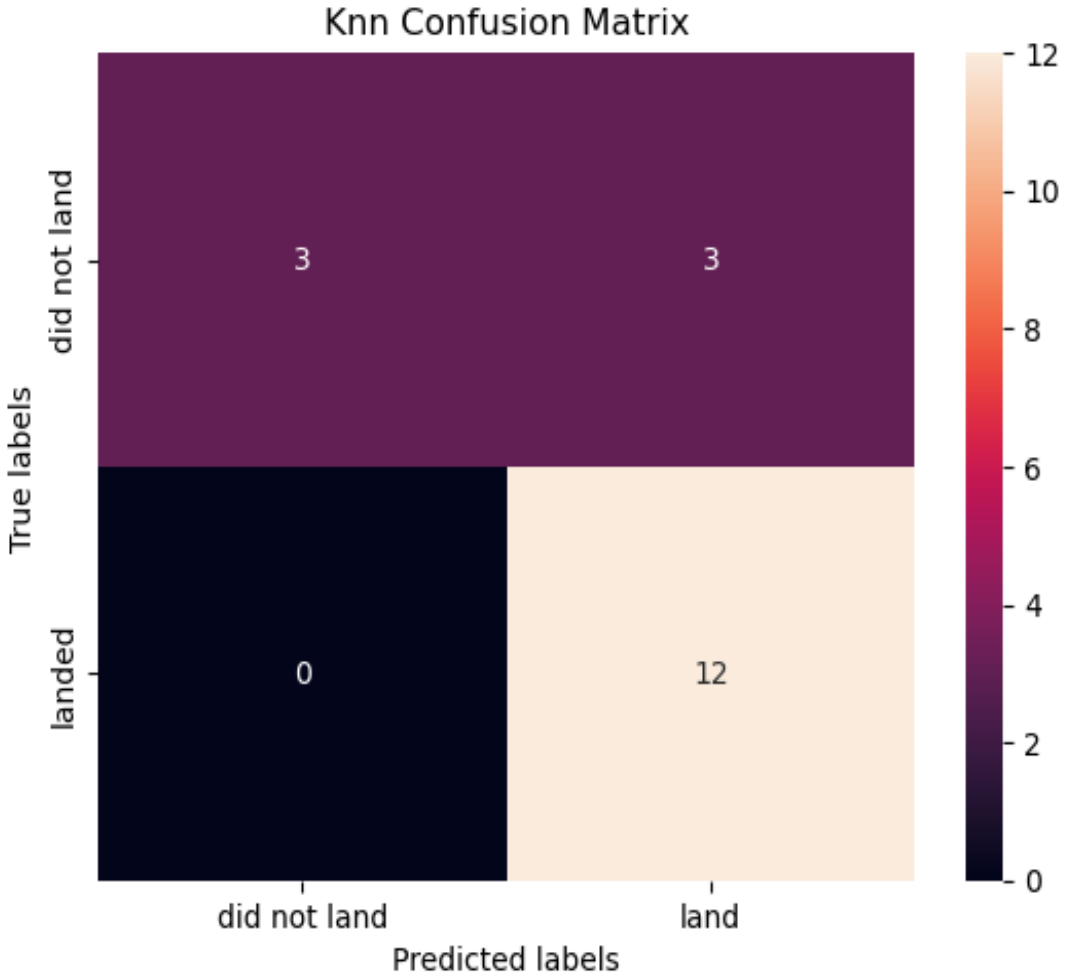
- Can information be gleamed about the chances of a successful landing.
- What factors contribute to a successful landing
- Under what circumstances does a successful landing take place
- Are there any lessons that can be learned by SpaceX to help SpaceY progress more quickly/efficiently

METHODOLOGY

- All data sourced came from the SpaceX Api via Skills Network or through Scraping Wikipedia
- Data Cleansing and Processing took place in Jupyter Notebook using a variety of packages.
- Data Visualizations were produced using Plotly/Dash, Seaborn, and Matplotlib
- Data Analysis was conducted using a number of Algorithms until the best results were found i.e.
  - Logistic Regression
  - Decision Tree
  - Support Vector Machine
  - K Nearest Neighbors ++ seems to be the best model

Optimal Parameters Were Found Using GridSearchCV For Each

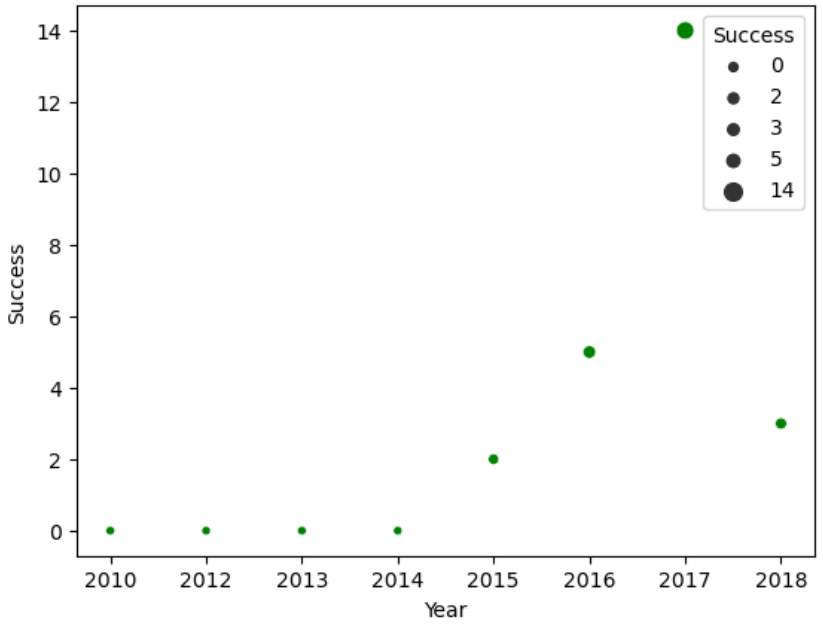
RESULTS



As Can Be Seen Here:
The Best Model: KNN
Could quite accurately determine a landing but false positives were abundant and essentially means you would have a 50/50 chance of accurately predicting a Failure. However, Landings seem quite easy to predict otherwise and the final result was an 83su[% chance of being correct. The failures of this model can be mitigated using the information further included in this presentation.

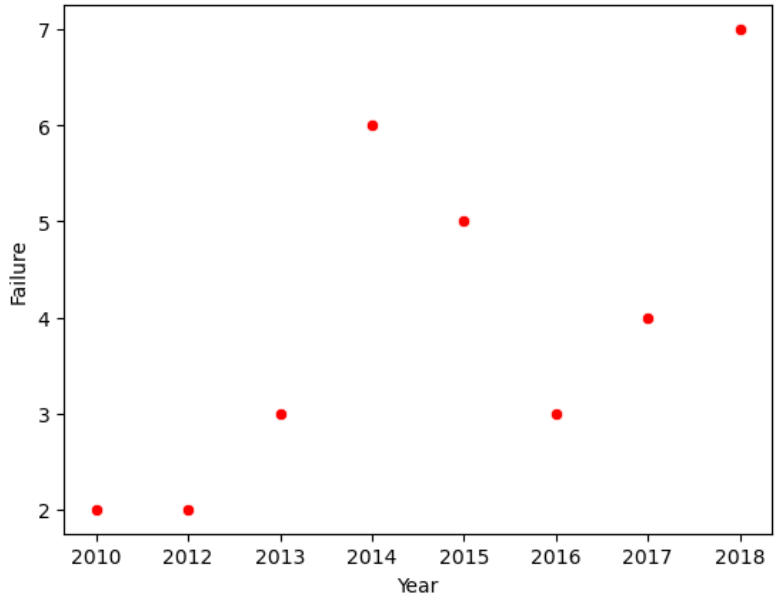
TRENDS

Success By Year



Year	Success	Failure
2010	0	2
2012	0	2
2013	0	3
2014	0	6
2015	2	5
2016	5	3
2017	14	4
2018	3	7

Failures By Year



Successful Landing Trends

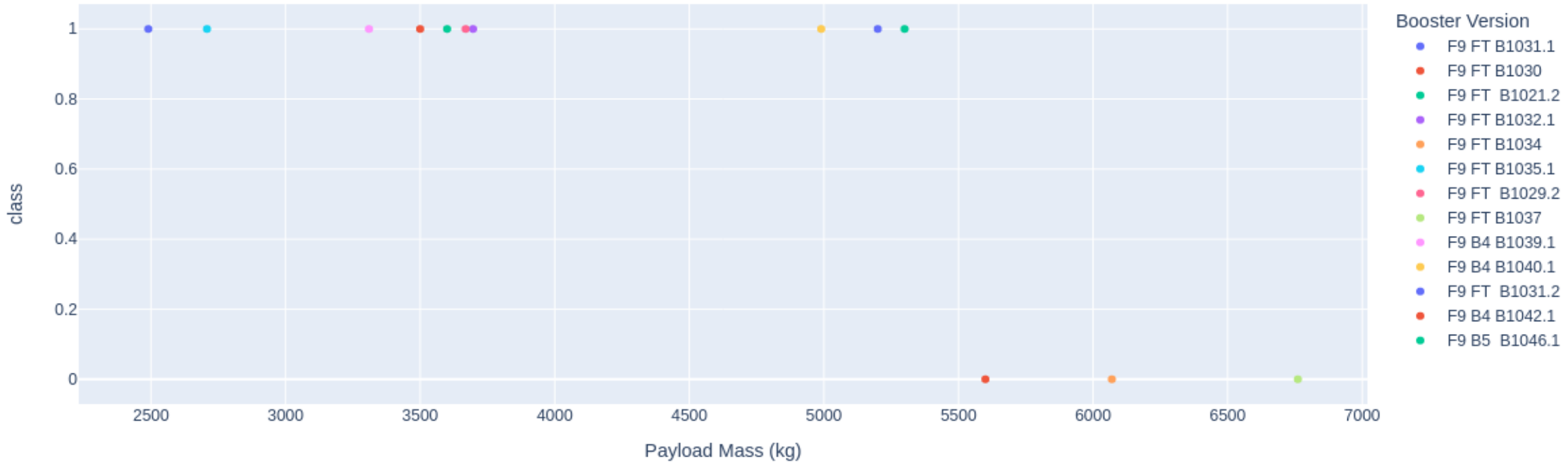
Findings

- Since 2017 Higher % Successes
- More Fails than Successes Overall
- Successes are dependent on a number of factors

Implications

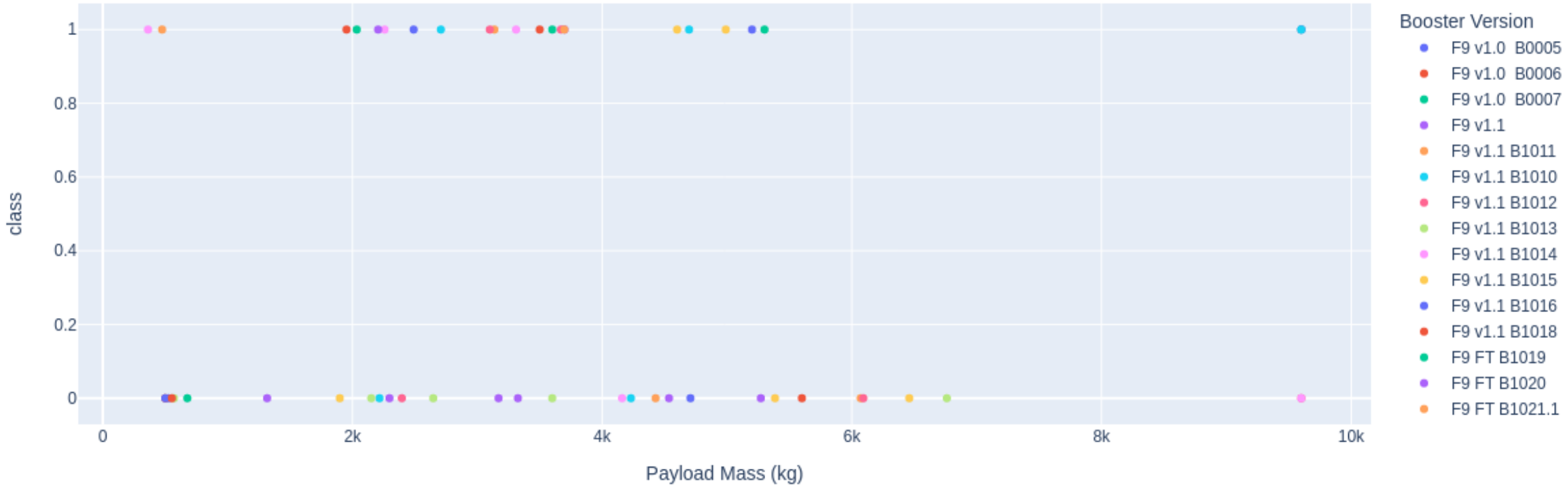
- Something Changed Here
- Starting SpaceY Will Probably Start In Failure To Some Extent
- Factors That Contribute To Success Should Be Optimized and Prioritized

Best Payload Criterium



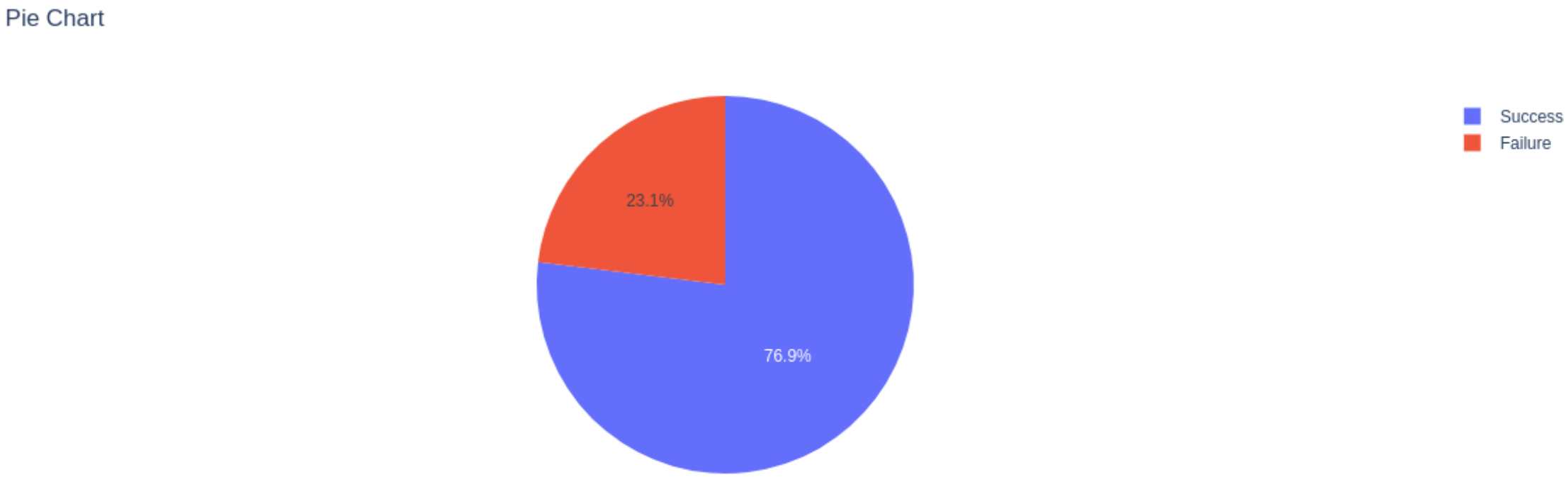
As Discussed Before, different payload weights 'x-axis' are seemingly a strong contributor to success
This Graph Shows Only Those Launch Sites From KSC LC-39A as it too has a high success rate.

All Weights



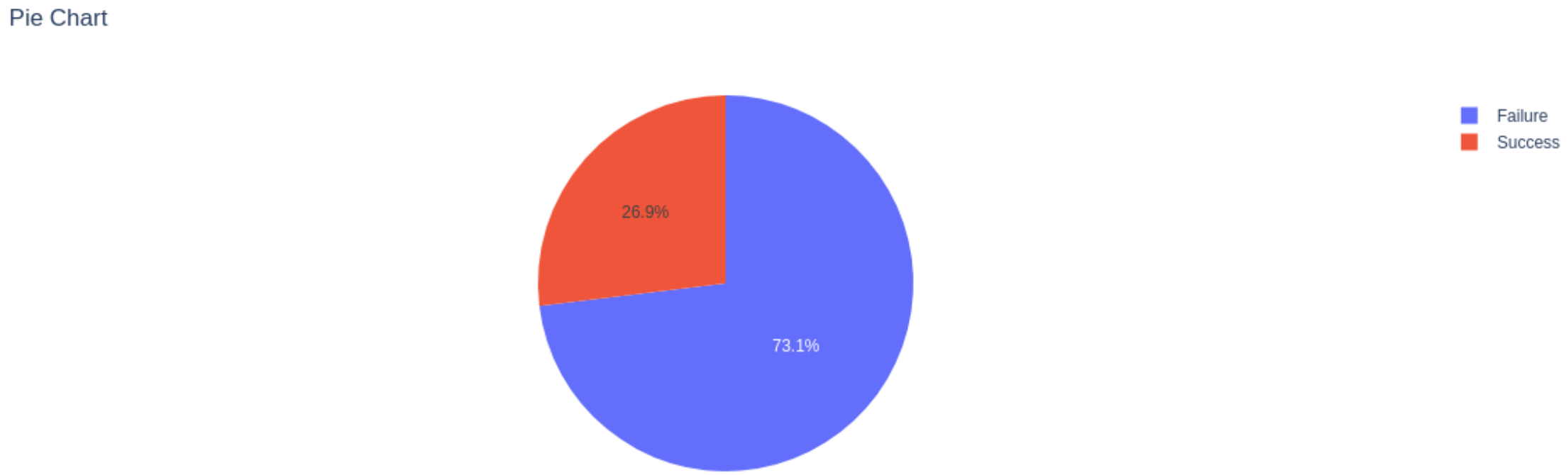
In Contrast This Graph Shows All Weights and All Launch Sites. Seemingly Launch Site Is A Stronger Indicator, But The Payload Has A Sweet Spot: Roughly 2000kg -> 6000kg Overall.

Launch Site KSC LC-39A Success Rate



Launch Site KSC LC-39A shows a 76.9% chance of success, not accounting for load.

Launch Site KSC CCAFS LC-40 Success Rate



In Contras KSC CCAFS LC-40 shows about the opposite in terms of odds.

Overall Successes By Landing

Rank the count of successful landing_outcomes between the date 04-06-2010 and 20-03-2017 in descending order.

```
%%sql
SELECT COUNT("Landing _Outcome") as success_count, "Landing _Outcome" FROM spacex
WHERE "Date" BETWEEN '04-06-2010' AND '20-03-2017'
AND "Landing _Outcome" LIKE '%Success%'
GROUP BY "Landing _Outcome"
ORDER BY success_count DESC
```

```
3 rows affected.
```

	success_count	Landing _Outcome
0	20	Success
1	8	Success (drone ship)
2	6	Success (ground pad)

We Can See Here All The Different Types Of Landings Given And How Many Each Has Provided A Successful Landing.

Best Booster Type

	Booster Version	class
0	F9 B4 B1039.2	0
1	F9 B4 B1040.2	0
2	F9 B4 B1041.2	0
3	F9 B4 B1043.2	0
4	F9 B4 B1039.1	1
5	F9 B4 B1040.1	1
6	F9 B4 B1041.1	1
7	F9 B4 B1042.1	1
8	F9 B4 B1043.1	1
9	F9 B4 B1044	0
10	F9 B4 B1045.1	1
11	F9 B5 B1046.1	1
12	F9 FT B1021.2	1
13	F9 FT B1029.2	1
14	F9 FT B1031.2	1
15	F9 FT B1032.2	0
16	F9 FT B1035.2	1
17	F9 FT B1036.2	0
18	F9 FT B1038.2	0
19	F9 FT B1019	1
20	F9 FT B1020	0
21	F9 FT B1021.1	1
22	F9 FT B1022	1
23	F9 FT B1023.1	1
24	F9 FT B1024	0
25	F9 FT B1025.1	1
26	F9 FT B1026	1
27	F9 FT B1029.1	1
28	F9 FT B1030	0
29	F9 FT B1031.1	1
30	F9 FT B1032.1	1
31	F9 FT B1034	0
32	F9 FT B1035.1	1
33	F9 FT B1036.1	1
34	F9 FT B1037	0

Class is a representation of success or failure:

1 = Success

0 = Failure

The Two Best Booster Types **B4** and **FT**:

FT has a Success Rate of 16/24 = 66.66R%

B4 has a Success Rate of 6/11 = 54.54R%

OVERALL FINDINGS & IMPLICATIONS

Findings

- At Site KSC LC-39A With **2500kg** > Payload < **5500kg** Has Never Failed.
- **KSC LC-39A** & **CCAFS LC-40** both have a high absolute number of successes. (**10**) and (**7**) respectively

Implications

- Specifics reasons should be learned to determine how to take advantage of these variables.
- These Locations and subsequent landings should be considered for future prospects

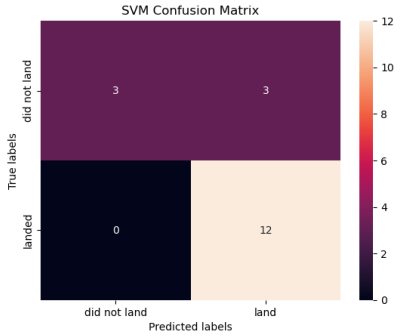
CONCLUSION

- Emulate Launch Sites
- Emulate Payloads
- Emulate Booster Types

Final Statements:

- Research is needed to learn exactly why certain launch sites lend themselves to better results.
- The end goal should be to create a niche for SpaceY using the information herein and after the above mentioned recommendation, thus becoming competetive at a substantially lesser startup cost.

APPENDIX



SVM Did Equally Well In Prediction

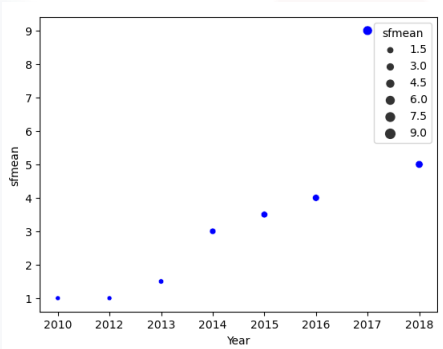
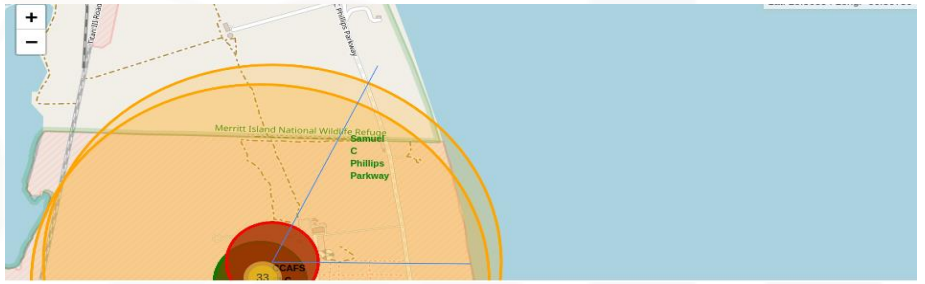


Chart of Squared Mean of (Success – Failure) of the charts shown earlier.



As Described, here is an example of a Launch Site Near the Ocean, Near a Highway as well as a railroad in top right corner. There are No Cities nearby, so a bit remote.

Thanks To IBM For Providing And Mostly Curing This Data :)