SpaceY's analysis on SpaceX

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20th Feb 2022

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- Methodology
- Results
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- Discussion
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EXECUTIVE SUMMARY

- Space Y's Business Intelligence Research
- Overview of Space X
- Analysis of Space X's Rocket Launches
  - Data Collection
  - Data Cleaning and Wrangling
  - Exploratory Data Analysis
- Understanding the Scale of Space X's Falcon 9
  - Price of each Launch
  - Reuse of the First Stage
- Predictive Analysis
  - Classification
  - Results.

INTRODUCTION

- SpaceX offers most budget friendly space flights and has consistently proved themselves to the clients.
- This is because of a lot of factors including their stage1 reusability and efficient planning.
- We have made certain observations which have revealed insights into how they are so good at what they do.

METHODOLOGY

- Data Collection
- Data Cleaning and Standardization.
- Exploratory Data Analysis.
- Visual analysis.
- Finding patterns.
- Formulating the hypothesis.
- Ascertain the hypothesis.
- Formulate the model.
- Validate the model.
- Deployment.

RESULTS

	FlightNumber	Date	BoosterVersion	PayloadMass	Orbit	LaunchSite	Outcome	Flights	GridFins	Reused	Legs	LandingPad	Block	Reused(
4	1	2010-06-04	Falcon 9	6123.547647	LEO	CCSFS SLC 40	None None	1	False	False	False	None	1.0	0
5	2	2012-05-22	Falcon 9	525.000000	LEO	CCSFS SLC 40	None None	1	False	False	False	None	1.0	0
6	3	2013-03-01	Falcon 9	677.000000	ISS	CCSFS SLC 40	None None	1	False	False	False	None	1.0	0
7	4	2013-09-29	Falcon 9	500.000000	PO	VAFB SLC 4E	False Ocean	1	False	False	False	None	1.0	0
8	5	2013-12-03	Falcon 9	3170.000000	GTO	CCSFS SLC 40	None None	1	False	False	False	None	1.0	0

RESULTS

Out[70]:

	Flight No.	Launch site	Payload	Payload mass	Orbit	Customer	Launch outcome	Version Booster	Booster landing	Date	Time
0	1	CCAFS	Dragon Spacecraft Qualification Unit	0	LEO	SpaceX	Success\n	F9 v1.1	Failure	4 June 2010	18:45
1	2	CCAFS	Dragon	0	LEO	NASA	Success	F9 v1.1	Failure	8 December 2010	15:43
2	3	CCAFS	Dragon	525 kg	LEO	NASA	Success	F9 v1.1	No attempt\n	22 May 2012	07:44
3	4	CCAFS	SpaceX CRS-1	4,700 kg	LEO	NASA	Success\n	F9 v1.1	No attempt	8 October 2012	00:35
4	5	CCAFS	SpaceX CRS-2	4,877 kg	LEO	NASA	Success\n	F9 v1.1	No attempt\n	1 March 2013	15:10

RESULTS

	FlightNumber	Date	BoosterVersion	PayloadMass	Orbit	LaunchSite	Outcome	Flights	GridFins	Reused	Legs	LandingPad	Block	Reused(
0	1	2010-06-04	Falcon 9	6104.959412	LEO	CCAFS SLC 40	None None	1	False	False	False	NaN	1.0	0
1	2	2012-05-22	Falcon 9	525.000000	LEO	CCAFS SLC 40	None None	1	False	False	False	NaN	1.0	0
2	3	2013-03-01	Falcon 9	677.000000	ISS	CCAFS SLC 40	None None	1	False	False	False	NaN	1.0	0
3	4	2013-09-29	Falcon 9	500.000000	PO	VAFB SLC 4E	False Ocean	1	False	False	False	NaN	1.0	0
4	5	2013-12-03	Falcon 9	3170.000000	GTO	CCAFS SLC 40	None None	1	False	False	False	NaN	1.0	0

RESULTS

Display the names of the unique launch sites in the space mission

```
%%sql
SELECT DISTINCT launch_site
FROM SPACEXDATASET;
```

[redacted]lqde00.databases.appdomain.cloud:30699/bludb

Done.

launch_site
CCAFS LC-40
CCAFS SLC-40
KSC LC-39A
VAFB SLC-4E

RESULTS

Display 5 records where launch sites begin with the string 'CCA'

```
%%sql
SELECT *
FROM SPACEXDATASET
WHERE launch_site LIKE 'CCA%' LIMIT 5;
```

```
 * ibm_db_sa://wnc69168:***@19af6446-6171-4641-8aba-9dcff8e1b6ff.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:30699/bludb
Done.
```

DATE	time_utc_	booster_version	launch_site	payload	payload_mass_kg_	orbit	customer	mission_outcome	landing_outcome
2010-06-04	18:45:00	F9 v1.0 B0003	CCAFS LC-40	Dragon Spacecraft Qualification Unit	0	LEO	SpaceX	Success	Failure (parachute)
2010-12-08	15:43:00	F9 v1.0 B0004	CCAFS LC-40	Dragon demo flight C1, two CubeSats, barrel of Brouere cheese	0	LEO (ISS)	NASA (COTS) NRO	Success	Failure (parachute)
2012-05-22	07:44:00	F9 v1.0 B0005	CCAFS LC-40	Dragon demo flight C2	525	LEO (ISS)	NASA (COTS)	Success	No attempt
2012-10-08	00:35:00	F9 v1.0 B0006	CCAFS LC-40	SpaceX CRS-1	500	LEO (ISS)	NASA (CRS)	Success	No attempt
2013-03-01	15:10:00	F9 v1.0 B0007	CCAFS LC-40	SpaceX CRS-2	677	LEO (ISS)	NASA (CRS)	Success	No attempt

RESULTS

Display the total payload mass carried by boosters launched by NASA (CRS)

```
%%sql
SELECT SUM(payload_mass__kg_) AS total_payload_mass
FROM SPACEXDATASET
WHERE customer = 'NASA (CRS)';
```

```
 * ibm_db_sa://wnc69168:***@19af6446-6171-4641-8aba-9dcff8e1b6ff.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:30699/bludb
Done.
```

total_payload_mass
45596

Task 4

Display average payload mass carried by booster version F9 v1.1

```
%%sql
SELECT AVG(payload_mass__kg_) AS avg_payload_mass_by_FP_V11
FROM SPACEXDATASET
WHERE booster_version LIKE 'F9 v1.1%';
```

```
 * ibm_db_sa://wnc69168:***@19af6446-6171-4641-8aba-9dcff8e1b6ff.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:30699/bludb
Done.
```

avg_payload_mass_by_fp_v11
2534

RESULTS

List the date when the first successful landing outcome in ground pad was acheived.

Hint:Use min function

```
%%sql
SELECT MIN(DATE) AS first_sucess_groun_pad
FROM SPACEXDATASET
WHERE landing__outcome = 'Success (ground pad)';
```

```
 * ibm_db_sa://wnc69168:***@19af6446-6171-4641-8aba-9dcff8e1b6ff.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:30699/bludb
Done.
```

first_sucess_groun_pad
2015-12-22

Task 6

List the names of the boosters which have success in drone ship and have payload mass greater than 4000 but less than 6000

```
%%sql
SELECT booster_version
FROM SPACEXDATASET
WHERE landing__outcome = 'Success (drone ship)' AND (payload_mass__kg_ < 6000 AND payload_mass__kg_> 4000);
```

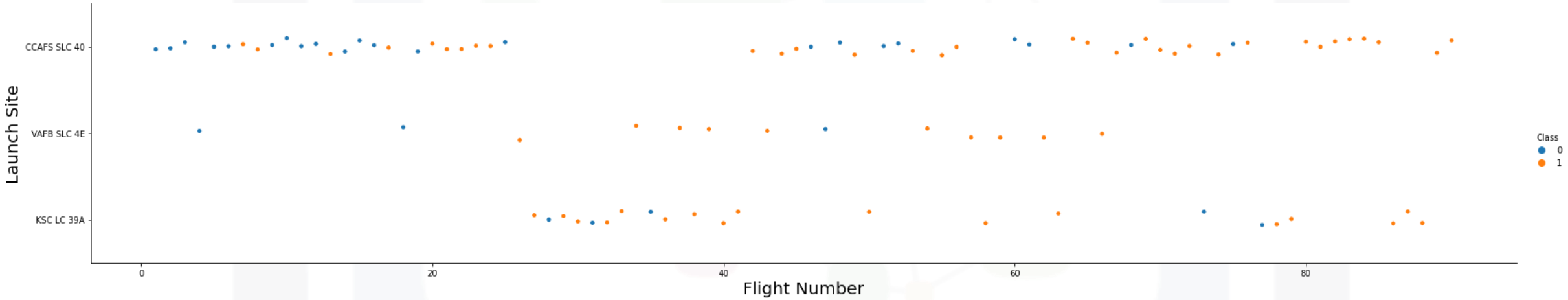
```
 * ibm_db_sa://wnc69168:***@19af6446-6171-4641-8aba-9dcff8e1b6ff.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:30699/bludb
Done.
```

booster_version
F9 FT B1022
F9 FT B1026
F9 FT B1021.2
F9 FT B1031.2

RESULTS

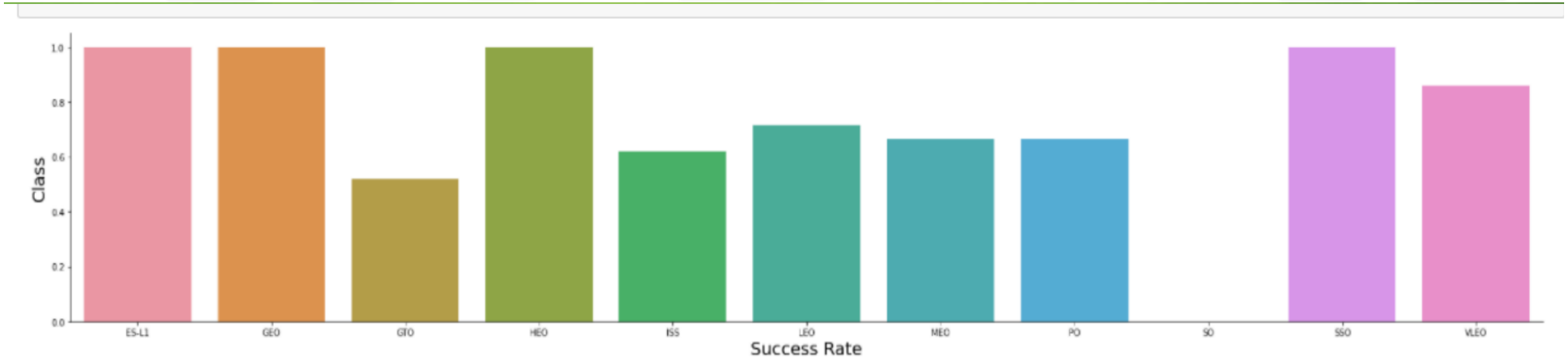
booster_version	payload_mass__kg_
F9 B5 B1048.4	15600
F9 B5 B1049.4	15600
F9 B5 B1051.3	15600
F9 B5 B1056.4	15600
F9 B5 B1048.5	15600
F9 B5 B1051.4	15600
F9 B5 B1049.5	15600
F9 B5 B1060.2	15600
F9 B5 B1058.3	15600
F9 B5 B1051.6	15600
F9 B5 B1060.3	15600
F9 B5 B1049.7	15600

Launch Sites

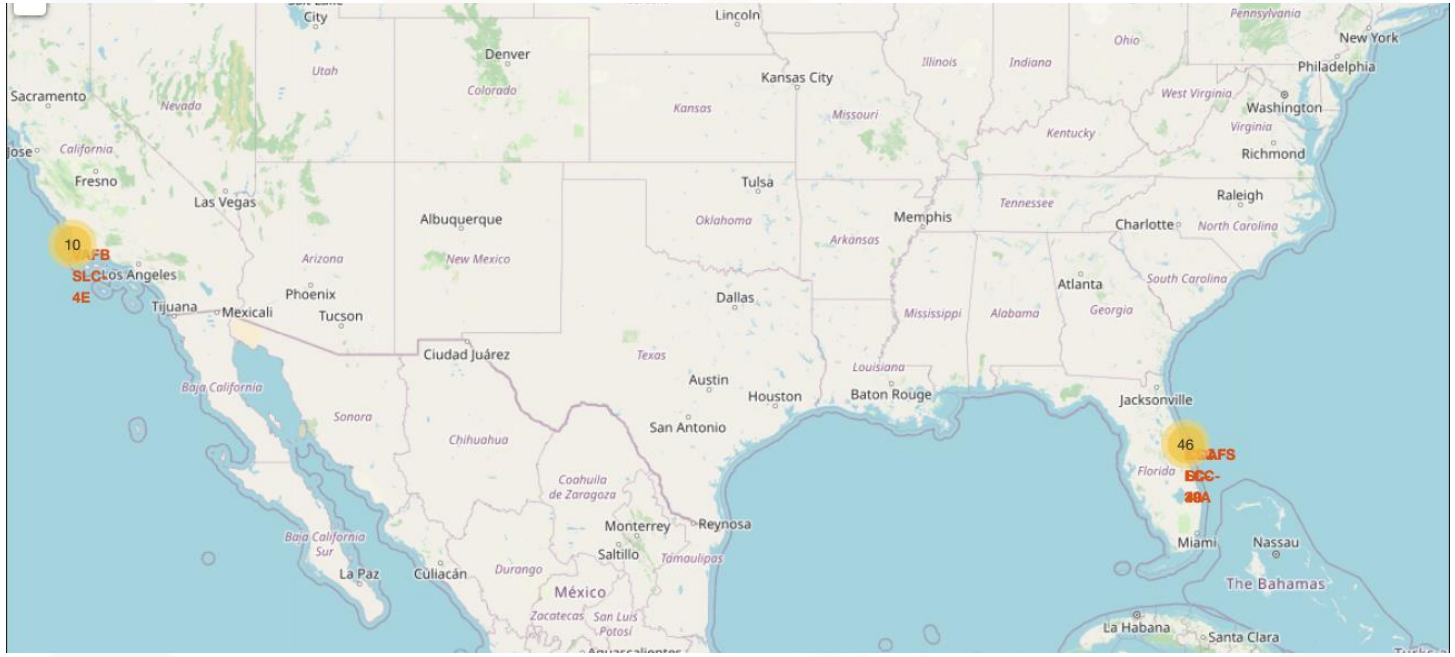


SpaceX started with CCAFS SLC40 initially and after some flights, they are again using it for the majority of their launches due to the stable weather conditions there.

Launch Sites

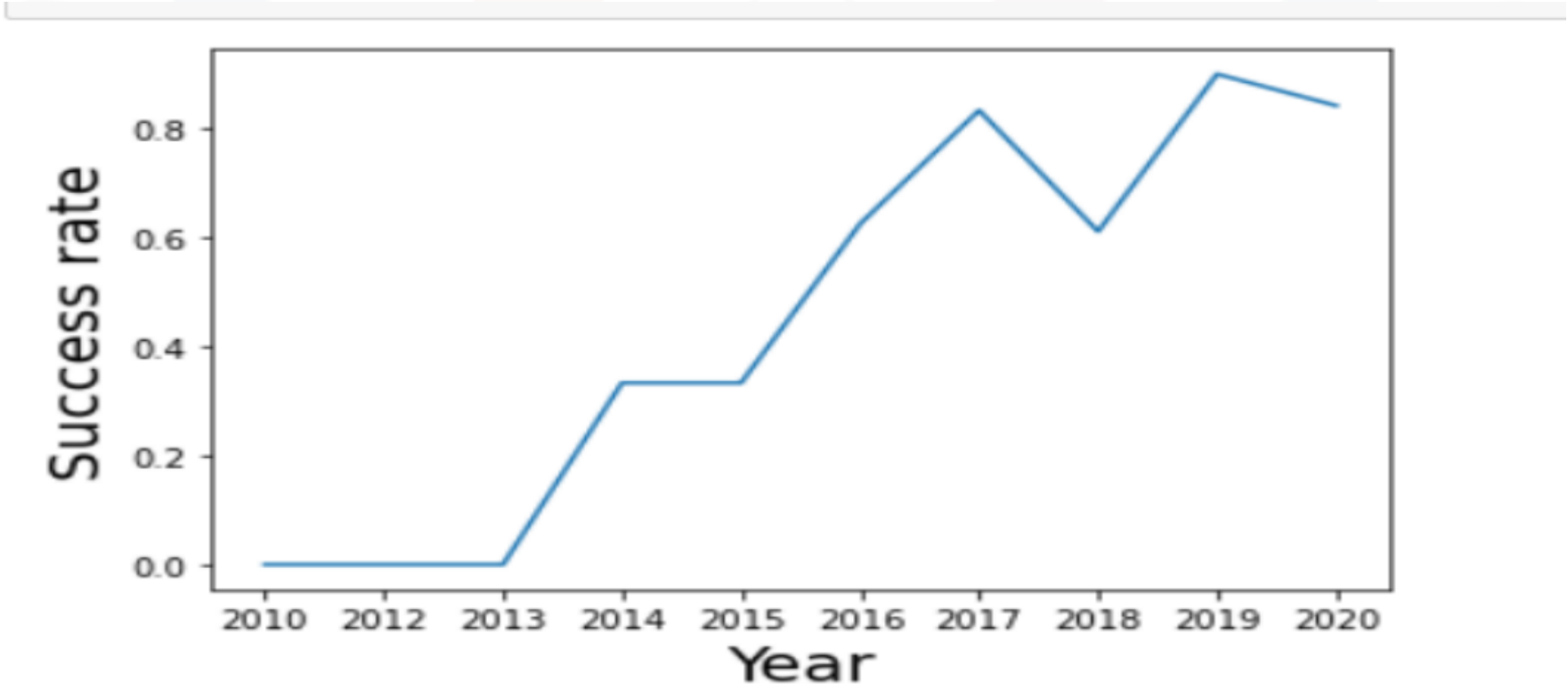


Launch Sites

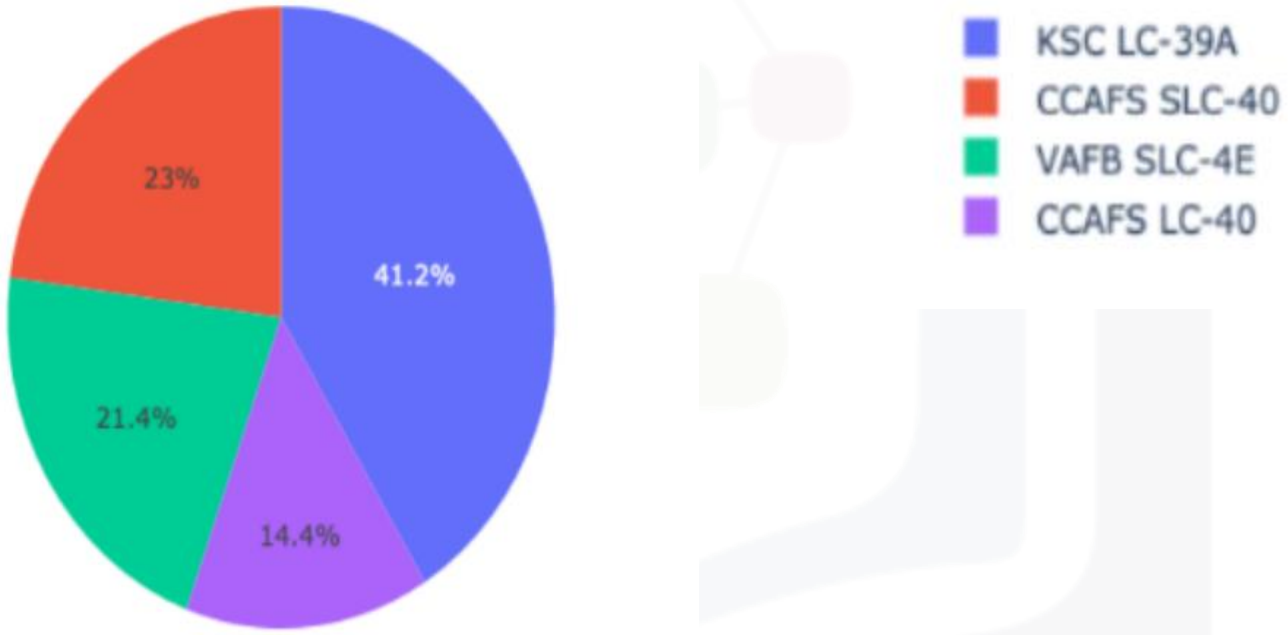


The launch sites are located at coasts to avoid any danger to the public in case of unsuccessful landings or launches.

Success Rate

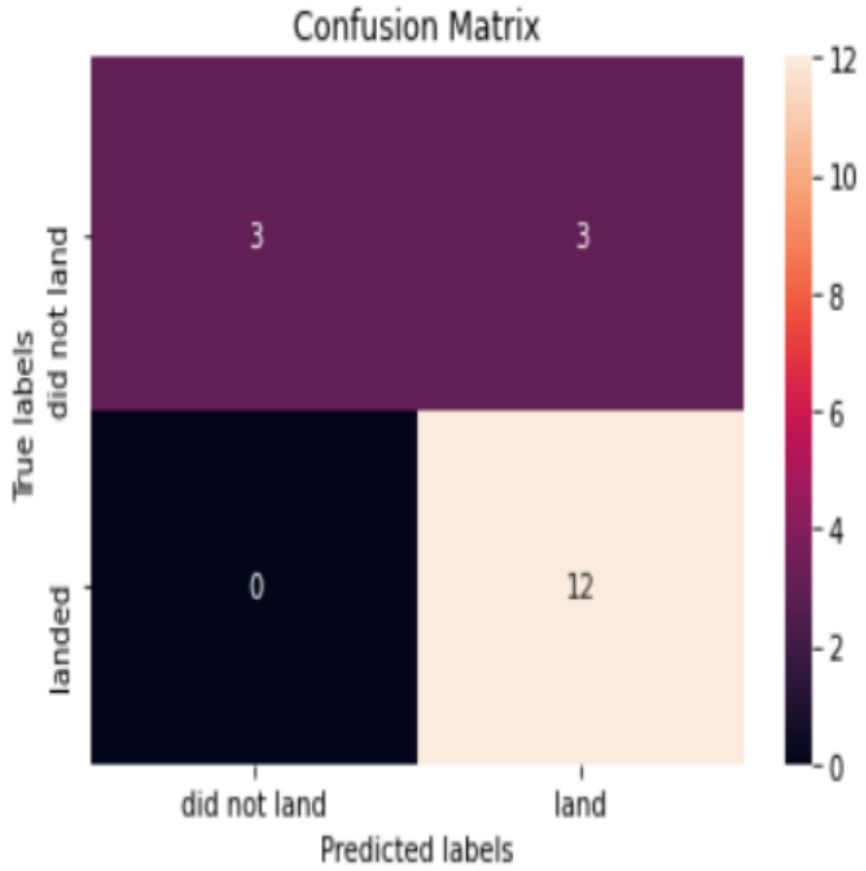


Successful Flights



Successful Flights

Model Evaluation



Discussion

SpaceX has continuously been improving its success rate and increasing the payload gradually.

However, this is not just because of the choices in location, timing and orbits, but also the fact that their technology is improving with time.

The experience of the early crashes must have encouraged SpaceX to explore more options and correlations.

CONCLUSION

- The CCAFS SLC40 is the best launch site to operate from.
- Payload, Orbit, Launch Site and Flight Numbers are all correlated to the First Stage Landing Success.
- Orbit types such as ES-L1, HEO, GEO and should be given good consideration by Space Y
- Lower payload masses should be avoided to minimize failures

ACKNOWLEDGEMENTS

- Thank you to the instructors for this amazing hands-on course.