Space Missions

about dataset:

All **space missions from 1957 to August 2022**, including details on the location, date, and result of the launch, the company responsible, and the name, price, and status of the rocket used for the mission.

- Company : name of the company
- location : the exact location of the mission
- Rocket : name of the Rocke used for mission
- statusRocket : status of rocket (is it Retired or active)
- country : the country
- Date : date of mission
- MissionStatus : is it Success or Failure or Partial Failure or Prelaunch Failure

Objectives

the objective is to analyze this dataset of space missions from 1957 to August 2022 to answer these questions and gain some insights :

1-How have rocket launches trended across time? Has mission success rate increased?

2-Which countries have had the most successful space missions? Has it always been that way?

3-Which rocket has been used for the most space missions? Is it still active?

4-Are there any patterns you can notice with the launch locations

In [2]:
```
import numpy as np
import pandas as pd
import plotly.express as px
import matplotlib.pyplot as plt
import seaborn as sns
import folium
%matplotlib inline
```

In [3]:
```
# read data
df = pd.read_csv('space_missions.csv', encoding='latin-1')
```

In [4]:
```
df.head()
```

Out[4]:

	Company	Location	Country	Date	Year	Rocket	Mission	RocketStatus	Price	MissionStatus
0	RVSN USSR	Site 1/5, Baikonur Cosmodrome, Kazakhstan	Kazakhstan	10/4/1957	1957	Sputnik 8K71PS	Sputnik-1	Retired	0	Success
1	RVSN USSR	Site 1/5, Baikonur Cosmodrome, Kazakhstan	Kazakhstan	11/3/1957	1957	Sputnik 8K71PS	Sputnik-2	Retired	0	Success
2	US Navy	LC-18A, Cape Canaveral AFS, Florida, USA	USA	12/6/1957	1957	Vanguard	Vanguard TV3	Retired	0	Failure
3	AMBA	LC-26A, Cape Canaveral AFS, Florida, USA	USA	2/1/1958	1958	Juno I	Explorer 1	Retired	0	Success
4	US Navy	LC-18A, Cape Canaveral AFS, Florida, USA	USA	2/5/1958	1958	Vanguard	Vanguard TV3BU	Retired	0	Failure

In [5]:
```
print('Number of columns: {}'.format(df.shape[0]))
print('Number of rows : {}'.format(df.shape[1]))
```

```
Number of columns: 4630
Number of rows : 10
```

In [6]:
```
df.columns
```

Out[6]:
```
Index(['Company', 'Location', 'Country', 'Date', 'Year', 'Rocket', 'Mission',
       'RocketStatus', 'Price', 'MissionStatus'],
      dtype='object')
```

In [7]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4630 entries, 0 to 4629
Data columns (total 10 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Company        4630 non-null   object
 1   Location       4630 non-null   object
 2   Country        4630 non-null   object
 3   Date           4630 non-null   object
 4   Year           4630 non-null   int64
 5   Rocket         4630 non-null   object
 6   Mission        4630 non-null   object
 7   RocketStatus   4630 non-null   object
 8   Price          1568 non-null   object
 9   MissionStatus  4630 non-null   object
dtypes: int64(1), object(9)
memory usage: 361.8+ KB
```

In [8]:
```
# drop price column because it has a lot of missing values
df.drop(['Price'], axis = 1 , inplace = True)
```

Data Cleaning and EDA

In [10]:
```
# remove duplicates rows if there is any
df.drop_duplicates()
```

Out[10]:

	Company	Location	Country	Date	Year	Rocket	Mission	RocketStatus	MissionStatus
0	RVSN USSR	Site 1/5, Baikonur Cosmodrome, Kazakhstan	Kazakhstan	10/4/1957	1957	Sputnik 8K71PS	Sputnik-1	Retired	Success
1	RVSN USSR	Site 1/5, Baikonur Cosmodrome, Kazakhstan	Kazakhstan	11/3/1957	1957	Sputnik 8K71PS	Sputnik-2	Retired	Success
2	US Navy	LC-18A, Cape Canaveral AFS, Florida, USA	USA	12/6/1957	1957	Vanguard	Vanguard TV3	Retired	Failure
3	AMBA	LC-26A, Cape Canaveral AFS, Florida, USA	USA	2/1/1958	1958	Juno I	Explorer 1	Retired	Success
4	US Navy	LC-18A, Cape Canaveral AFS, Florida, USA	USA	2/5/1958	1958	Vanguard	Vanguard TV3BU	Retired	Failure
...	...	...	...	...	...	...	...	...	...
4625	SpaceX	SLC-4E, Vandenberg SFB, California, USA	USA	7/22/2022	2022	Falcon 9 Block 5	Starlink Group 3-2	Active	Success
4626	CASC	LC-101, Wenchang Satellite Launch Center, China	China	7/24/2022	2022	Long March 5B	Wentian	Active	Success
4627	SpaceX	LC-39A, Kennedy Space Center, Florida, USA	USA	7/24/2022	2022	Falcon 9 Block 5	Starlink Group 4-25	Active	Success
4628	CAS Space	Jiuquan Satellite Launch Center, China	China	7/27/2022	2022	Zhongke-1A	Demo Flight	Active	Success
4629	CASC	LC-3, Xichang Satellite Launch Center, China	China	7/29/2022	2022	Long March 2D	Yaogan 35 Group 03	Active	Success

4629 rows × 9 columns

In [104…
```
# let's descover the number of lunches of each company
df_company = df['Company'].value_counts().reset_index()
df_company.columns = ['Company','Number of Launches']

df_company.head()
```

Out[104]:

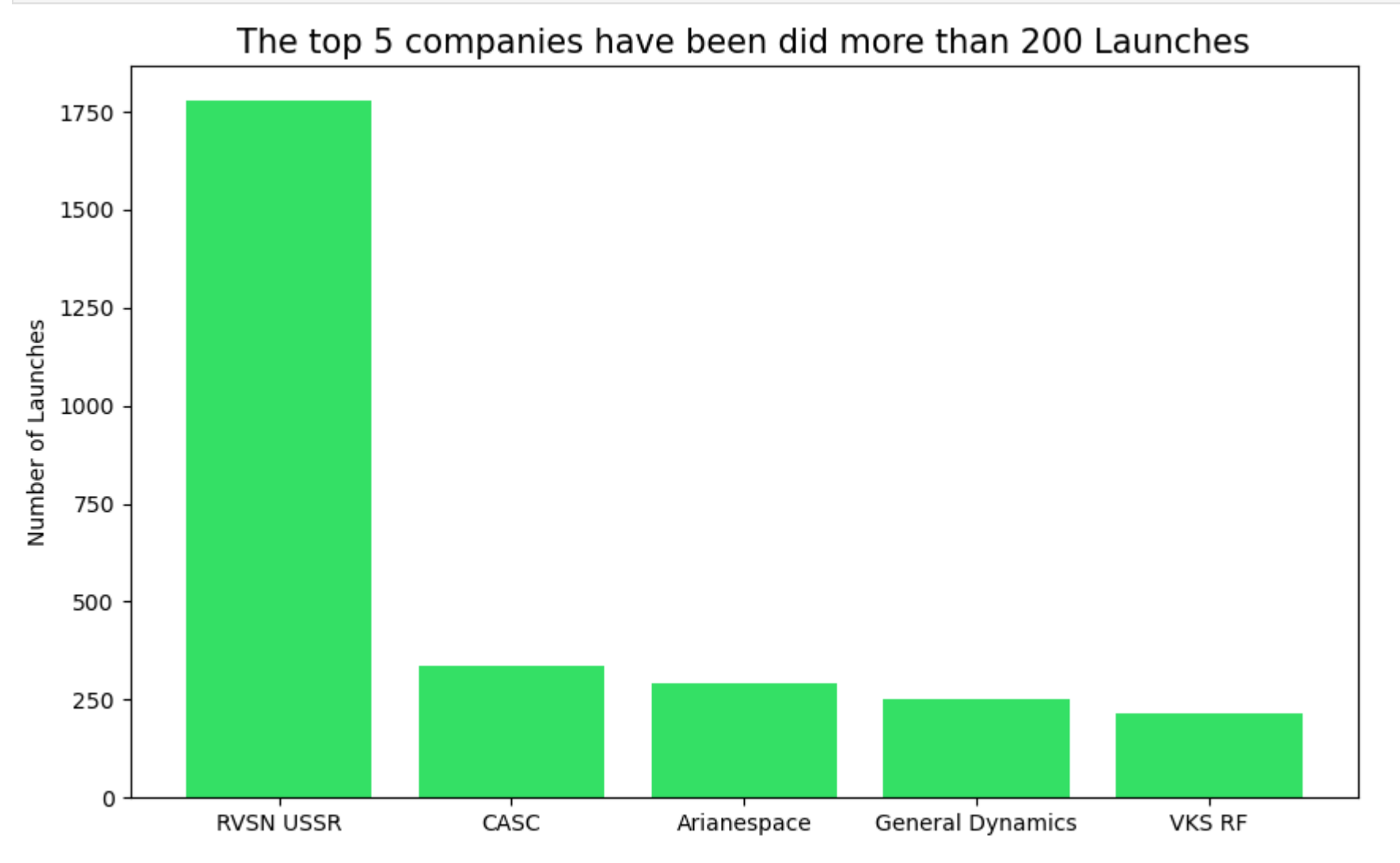
	Company	Number of Launches
0	RVSN USSR	1777
1	CASC	338
2	Arianespace	293
3	General Dynamics	251
4	VKS RF	216

In [106…
```
# Top 5  company has been did more than 200 lunches
top5 = df_company.head(5)

fig, ax = plt.subplots(figsize = (10,6))
ax.bar(top5['Company'], top5['Number of Launches'], color = '#34e065')

ax.set_title('The top 5 companies have been did more than 200 Launches',fontsize =15)
ax.set_ylabel('Number of Launches')

plt.show()
```



In [107…
```
df_mission = df['MissionStatus'].value_counts().sort_values(ascending = False).reset_index()
df_mission.columns = ['Mission Status','Number of Launches']

df_mission
```

Out[107]:

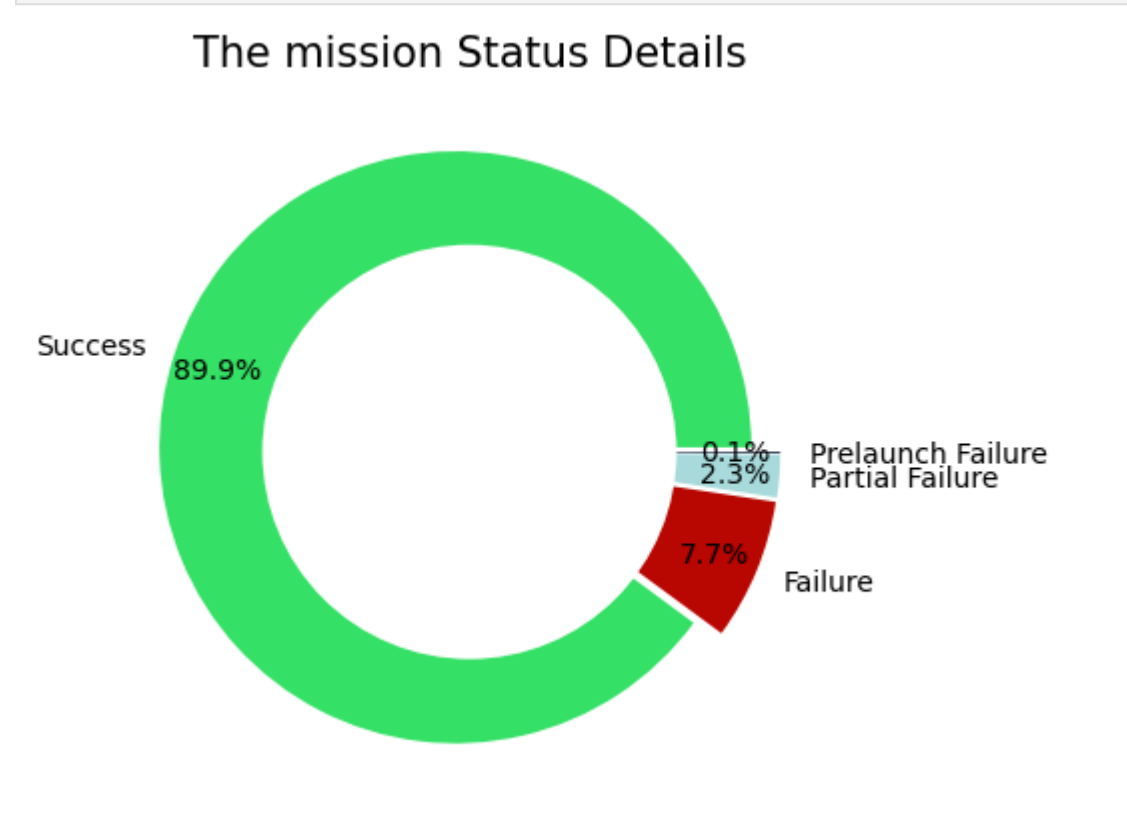
	Mission Status	Number of Launches
0	Success	4162
1	Failure	357
2	Partial Failure	107
3	Prelaunch Failure	4

In [117…
```
fig, ax = plt.subplots()
colors = ['#34e065', '#b80600', '#a8dadc','#14213d']
explode = (0.05, 0.05, 0.05, 0.05)

# Pie Chart
ax.pie(df_mission['Number of Launches'],
       colors=colors,
       labels=df_mission['Mission Status']
       ,autopct='%1.1f%%',
       pctdistance=0.85,
       explode=explode )

centre_circle = plt.Circle((0, 0), 0.70, fc='white')
fig = plt.gcf()


fig.gca().add_artist(centre_circle)
ax.set_title('The mission Status Details', fontsize = 15)
plt.show()
```



Some Interesting Questions

Q1- Which countries have had the most successful space missions

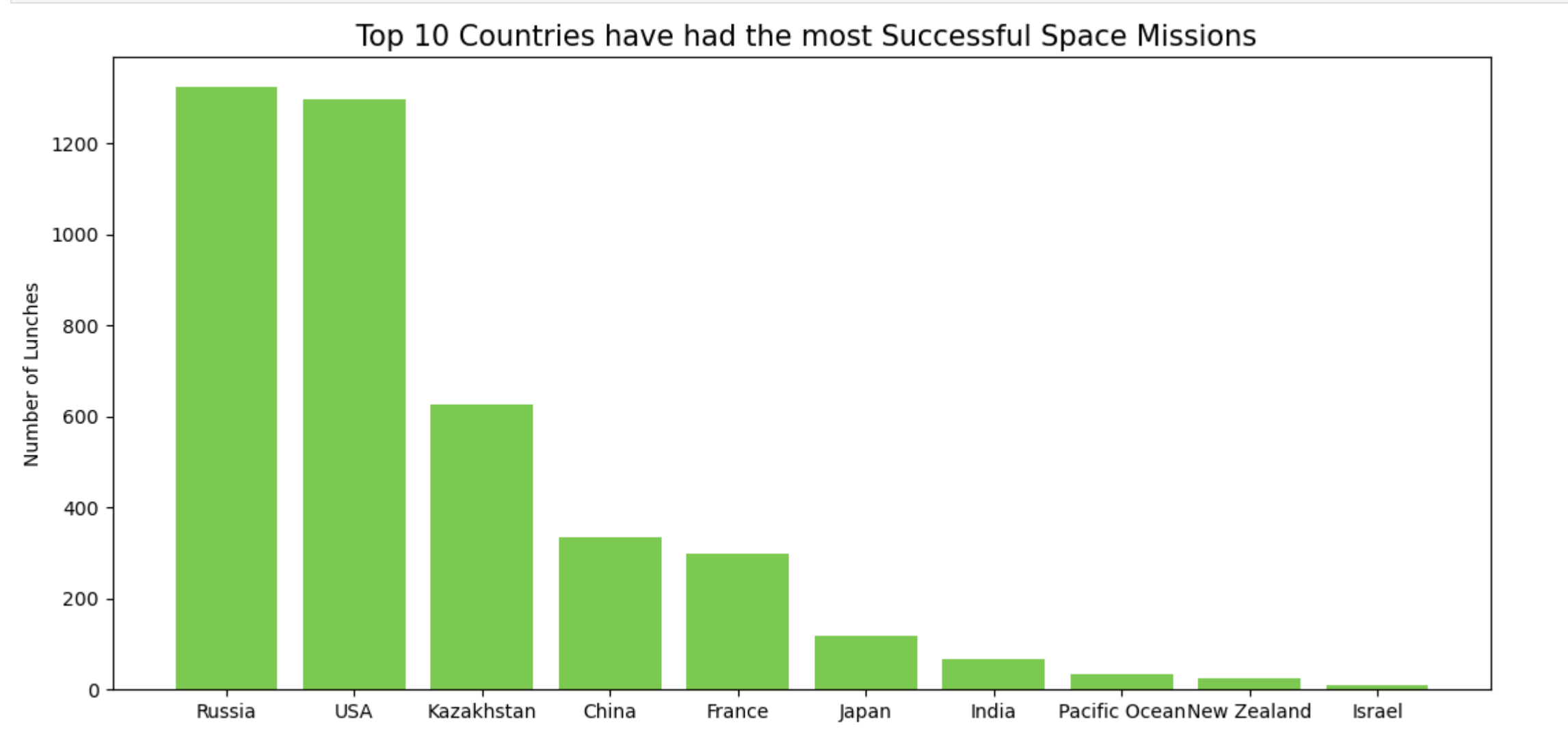
In [39]:
```
# Q1- Which countries have had the most successful space missions
df_success = df[df['MissionStatus'] == 'Success']
countries = df_success['Country'].value_counts().reset_index()
countries.columns = ['country', 'nbr_missions']

df_top10 = countries.head(10)
```

In [86]:
```
fig,ax =plt.subplots(figsize=(13,6))

ax.bar(df_top10['country'],df_top10['nbr_missions'], color = '#7bc950')
plt.title(' Top 10 Countries have had the most Successful Space Missions', fontsize = '15')

plt.ylabel('Number of Launches')
plt.show()
```



Q2 How have rocket launches trended across time? Has mission success rate increased?

In [109…
```
# Convert the 'date' column to datetime
df['date'] = pd.to_datetime(df['Date'])

# Calculate the mission success rate for each year
success_rate = df[df['MissionStatus'] == 'Success'].groupby('Year')['MissionStatus'].count() / df.groupby('Year')['MissionStatus'].count() * 100
success_rate.head()
```

Out[109]:
```
Year
1957    66.666667
1958    21.428571
1959    40.000000
1960    48.717949
1961    61.538462
Name: MissionStatus, dtype: float64
```

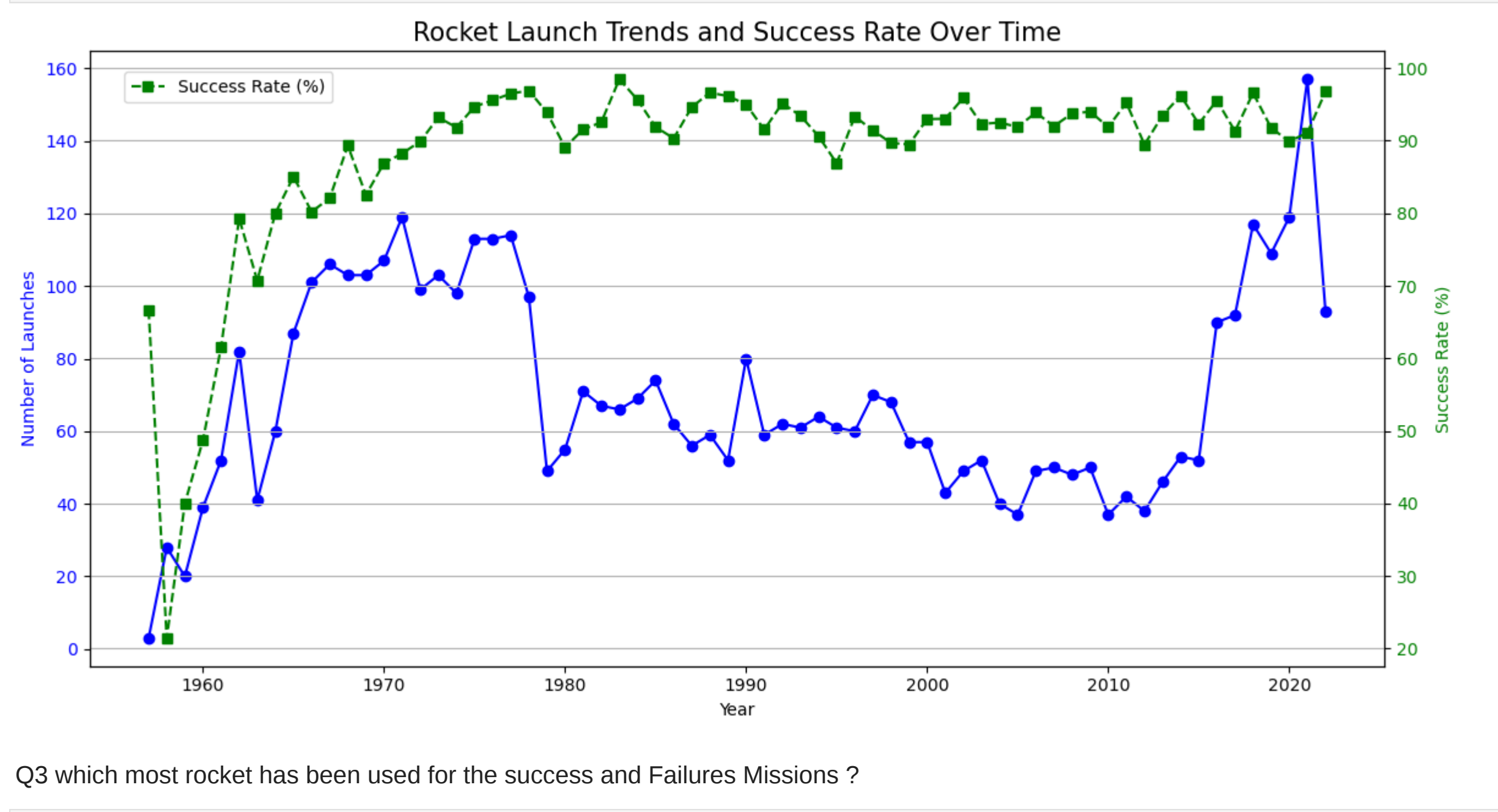
In [110…
```
# Create a figure and axis
fig, ax1 = plt.subplots(figsize=(12, 6))

# Plot the number of launches per year
launches_per_year = df.groupby('Year')['date'].count()
ax1.plot(launches_per_year.index, launches_per_year.values, color='b', marker='o', label='Number of Launches')
ax1.set_xlabel('Year')
ax1.set_ylabel('Number of Launches', color='b')
ax1.tick_params(axis='y', labelcolor='b')

# Create a second y-axis for the success rate
ax2 = ax1.twinx()
ax2.plot(success_rate.index, success_rate.values, color='g', marker='s', linestyle='--', label='Success Rate (%)')
ax2.set_ylabel('Success Rate (%)', color='g')
ax2.tick_params(axis='y', labelcolor='g')

# Add titles and legends
plt.title('Rocket Launch Trends and Success Rate Over Time',fontsize= 15)
plt.grid(True)
plt.legend(loc='upper left', bbox_to_anchor=(0.02, 0.98))

# Show the plot
plt.tight_layout()
plt.show()
```

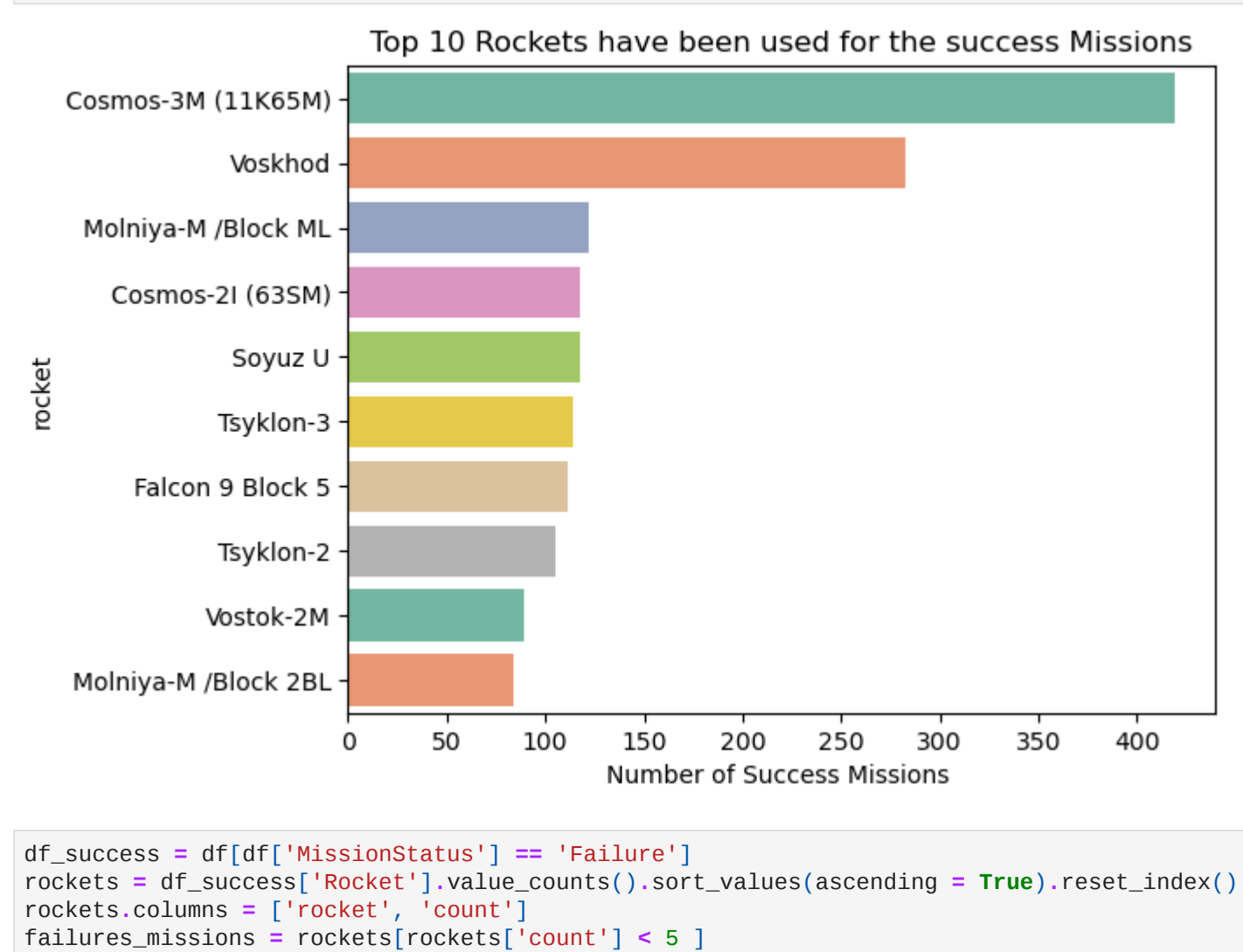


Q3 which most rocket has been used for the success and Failures Missions ?

In [119…
```
df_success = df[df['MissionStatus'] == 'Success']
rockets = df_success['Rocket'].value_counts().sort_values(ascending = False).reset_index().head(10)
rockets.columns = ['rocket', 'count']
```

In [120…
```
res = sns.barplot(x = 'count', y ='rocket', data = rockets, palette = 'Set2')
plt.title('Top 10 Rockets have been used for the success Missions')
plt.xlabel('Number of Success Missions ')


plt.show()
```

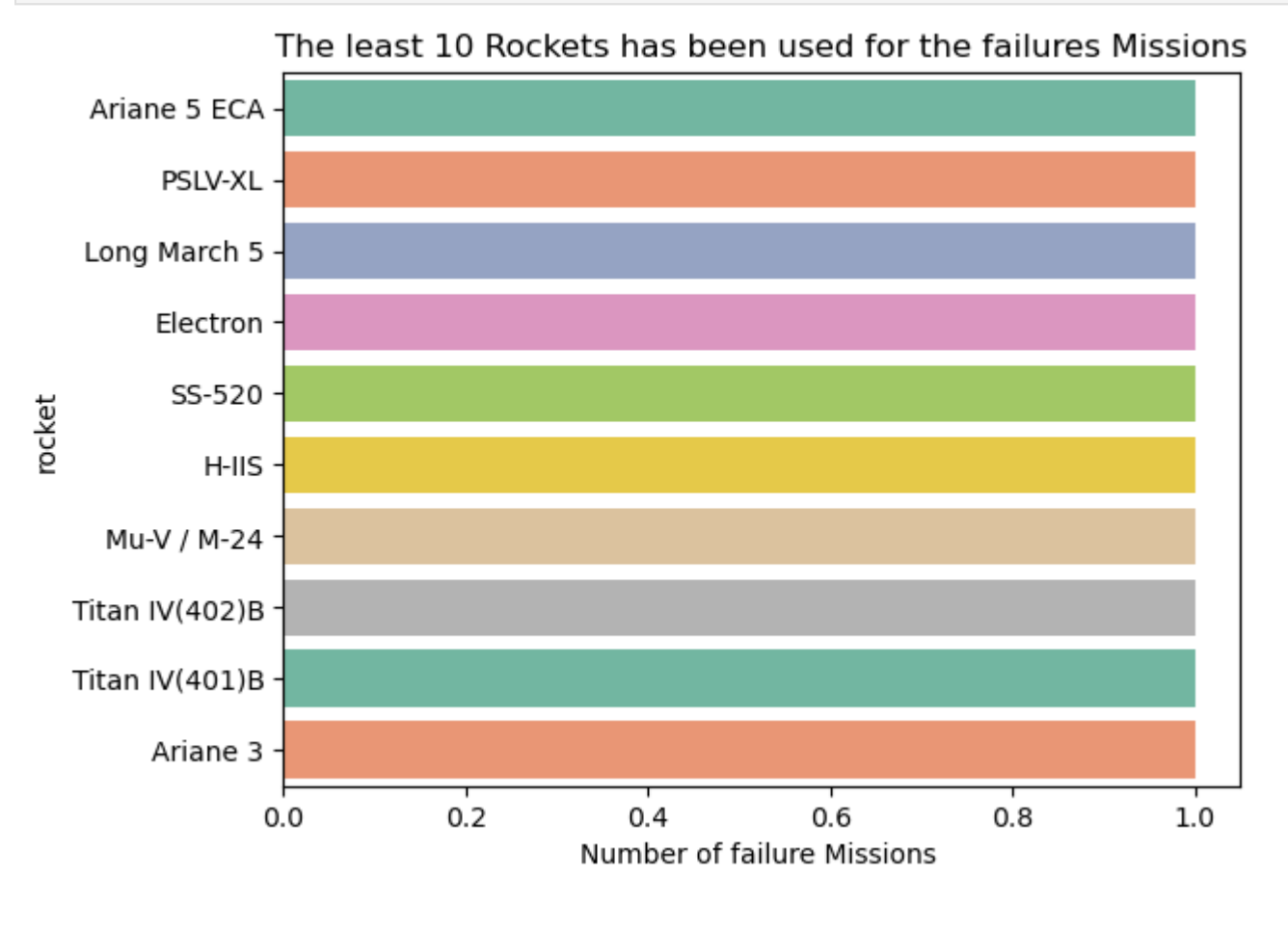


Top 10 Rockets have been used for the success Missions
rocket
Cosmos-3M (11K65M)
Voskhod
Molniya-M /Block ML
Cosmos-2I (63SM)
Soyuz U
Tsyklon-3
Falcon 9 Block 5
Tsyklon-2
Vostok-2M
Molniya-M /Block 2BL
0
50
100
150
200
250
300
350
400
Number of Success Missions

In [121…
```
df_success = df[df['MissionStatus'] == 'Failure']
rockets = df_success['Rocket'].value_counts().sort_values(ascending = True).reset_index()
rockets.columns = ['rocket', 'count']
failures_missions = rockets[rockets['count'] < 5 ]
least10 = failures_missions.head(10)
```

In [113…
```
res = sns.barplot(x = 'count', y ='rocket', data = least10, palette = 'Set2')
plt.title('The least 10 Rockets have been used for the failures Missions')
plt.xlabel('Number of failure Missions ')


plt.show()
```



Q4 which company has a good success missions and which Rocket used

In [125…
```
# Q1- Which countries have had the most successful space missions
df_success = df[df['MissionStatus'] == 'Success']
companies = df_success['Company'].value_counts().reset_index()
companies.columns = ['company','successMissions']
companies.head()
```

Out[125]:

	company	successMissions
0	RVSN USSR	1614
1	CASC	318
2	Arianespace	282
3	General Dynamics	203
4	VKS RF	202

In [126…
```
# Calculate the mission success rate for each company
company_success_rate = df[df['MissionStatus'] == 'Success'].groupby('Company')['MissionStatus'].count() / df.groupby('Company')['MissionStatus'].count() * 100

# Find the company with the highest success rate
best_company = company_success_rate.idxmax()
best_success_rate = company_success_rate.max()

print(f"The company with the highest success rate is {best_company} with a success rate of {best_success_rate:.2f}%.")

# Find the rockets used by the best company in successful missions
best_company_successful_rockets = df[(df['Company'] == best_company) & (df['MissionStatus'] == 'Success')]['Rocket'].unique()

print(f"The rockets used by {best_company} in successful missions are:")
for rocket in best_company_successful_rockets:
    print(rocket)
```

```
The company with the highest success rate is ASI with a success rate of 100.00%.
The rockets used by ASI in successful missions are:
Scout B
Scout D1
Scout B1
Scout F1
Scout G1
```

In [ ]: