Space Missions Analysis

Group-2

Importing Libraries

```
import pandas as pd  #pandas is a data manipulation and analysis tool
import numpy as np   #numpy is the library for numerical computation
import seaborn as sns  #seaborn is a library for making statistical graphics
import matplotlib.pyplot as plt  #Matplotlib is a plotting library
import plotly.express as px   #plotly.express provides consistent and interactive figures
```

```
#Read the csv file
df=pd.read_csv('/content/drive/MyDrive/Space_Corrected.csv')
df.head()
```

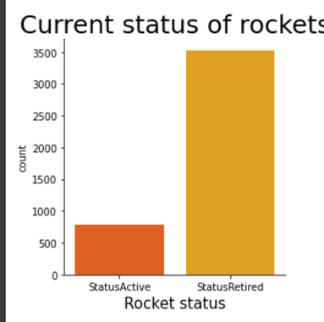
	Unnamed: 0	Unnamed: 0.1	Company Name	Location	Datum	Detail	Status Rocket	Rocket	Status Mission
0	0	0	SpaceX	LC-39A, Kennedy Space Center, Florida, USA	Fri Aug 07, 2020 05:12 UTC	Falcon 9 Block 5 | Starlink V1 L9 & BlackSky	StatusActive	50.0	Success
1	1	1	CASC	Site 9401 (SLS-2), Jiuquan Satellite Launch Ce...	Thu Aug 06, 2020 04:01 UTC	Long March 2D | Gaofen-9 04 & Q-SAT	StatusActive	29.75	Success
2	2	2	SpaceX	Pad A, Boca Chica, Texas, USA	Tue Aug 04, 2020 23:57 UTC	Starship Prototype | 150 Meter Hop	StatusActive	NaN	Success
3	3	3	Roscosmos	Site 200/39, Baikonur Cosmodrome, Kazakhstan	Thu Jul 30, 2020 21:25 UTC	Proton-M/Briz-M | Ekspress-80 & Ekspress-103	StatusActive	65.0	Success
4	4	4	ULA	SLC-41, Cape Canaveral AFS, Florida, USA	Thu Jul 30, 2020 11:50 UTC	Atlas V 541 | Perseverance	StatusActive	145.0	Success

Visualizations

Current Status of the Rockets

```
#To draw the category plot of Status rocket column
sns.catplot('Status Rocket',kind='count',data=df,height=4,palette='autumn')
plt.title('Current status of rockets',size=25)
plt.xlabel('Rocket status',size=15)
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning:

Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
```



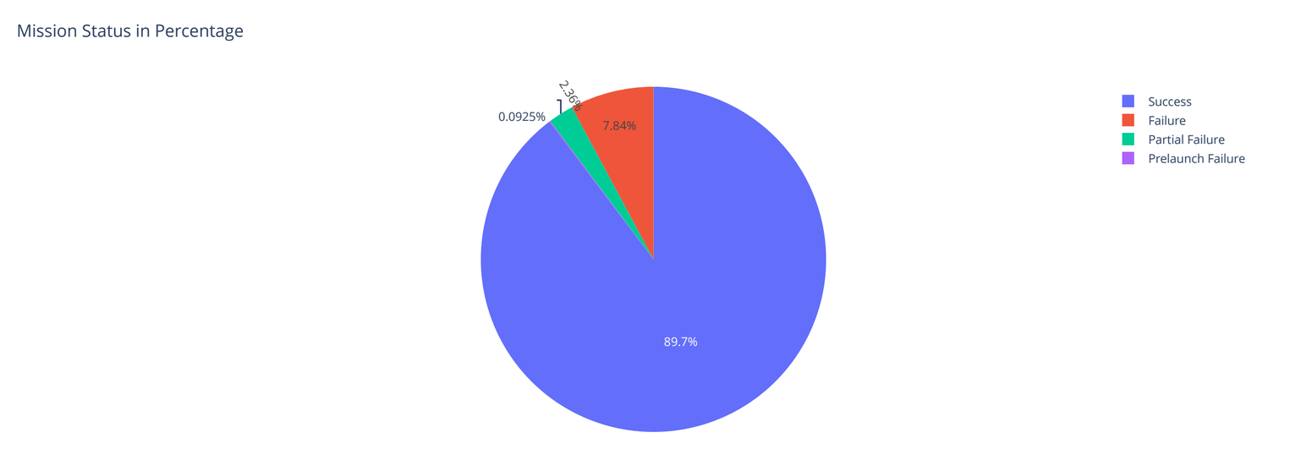
Conclusion: Most of the rockets are retired

Mission Status

```
#to get the count of each mission status
data = df['Status Mission'].value_counts().reset_index()
data.columns = [
    'Status Mission',
    'count'
]
print(data)
```

```
      Status Mission  count
0            Success   3879
1            Failure    339
2    Partial Failure    102
3  Prelaunch Failure      4
```

```
#plotting a pie graph to show the mission status
fig = px.pie(
    data,
    values='count',
    names='Status Mission',
    title='Mission Status in Percentage',
)

fig.show()
```



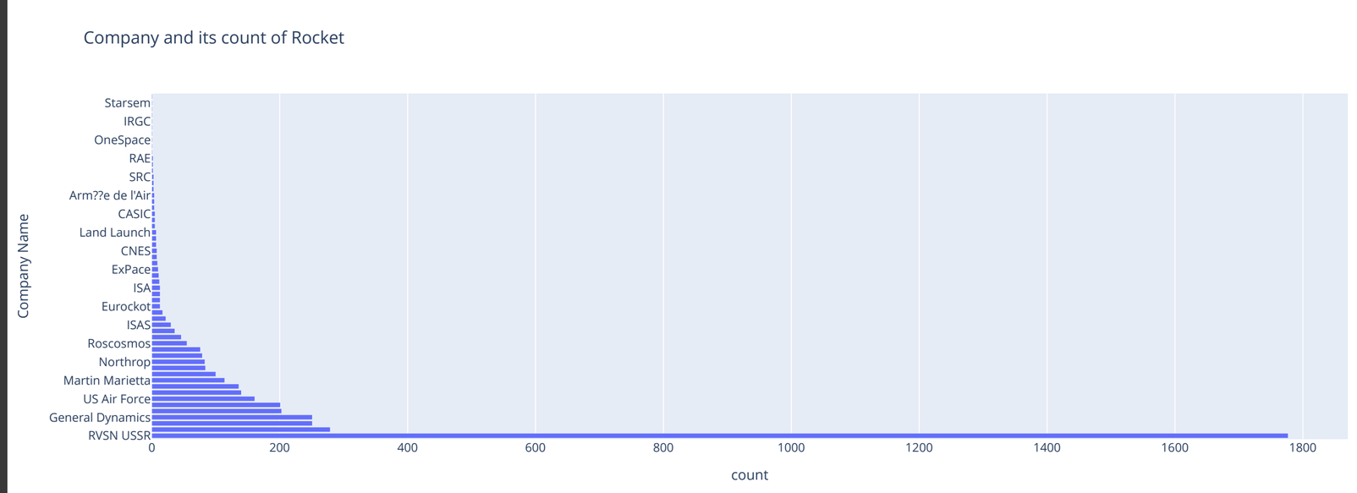
Conclusion: Majority of the status mission is success while the minimum is prelaunch failure

Company

```
#To get the number of rockets owned per company
data = df['Company Name'].value_counts().reset_index()

data.columns = [
    'Company Name',
    'count'
]

print(data)
```

```
         Company Name  count
0           RVSN USSR   1777
1         Arianespace    279
2                CASC    251
3    General Dynamics    251
4                NASA    203
5              VKS RF    201
6        US Air Force    161
7                 ULA    140
8              Boeing    136
9     Martin Marietta    114
10             SpaceX    100
11                MHI     84
12           Northrop     83
13           Lockheed     79
14               ISRO     76
15          Roscosmos     55
16                ILS     46
17         Sea Launch     36
18               ISAS     30
19          Kosmotras     22
20            US Navy     17
21          Eurockot     13
22                ESA     13
23         Rocket Lab     13
24                ISA     13
25        Blue Origin     12
26                IAI     11
27            ExPace     10
28                ASI      9
29               AMBA      8
30               CNES      8
31               JAXA      7
32               MITT      7
33        Land Launch      7
34                 UT      5
35               KCST      5
36              CASIC      5
37               Exos      4
38             CECLES      4
39    Arm??e de l'Air      4
40               KARI      3
41                AEB      3
42                SRC      3
43            OKB-586      2
44           Yuzhmash      2
45                RAE      2
46          Landspace      1
47       Virgin Orbit      1
48           OneSpace      1
49            Douglas      1
50         Khrunichev      1
51               IRGC      1
52                EER      1
53            i-Space      1
54            Starsem      1
55             Sandia      1
```

```
#plotting the bar graph for company
fig = px.bar(
    data,
    x='count',
    y='Company Name',
    orientation='h',
    title='Company and its count of Rocket'
)

fig.show()
```

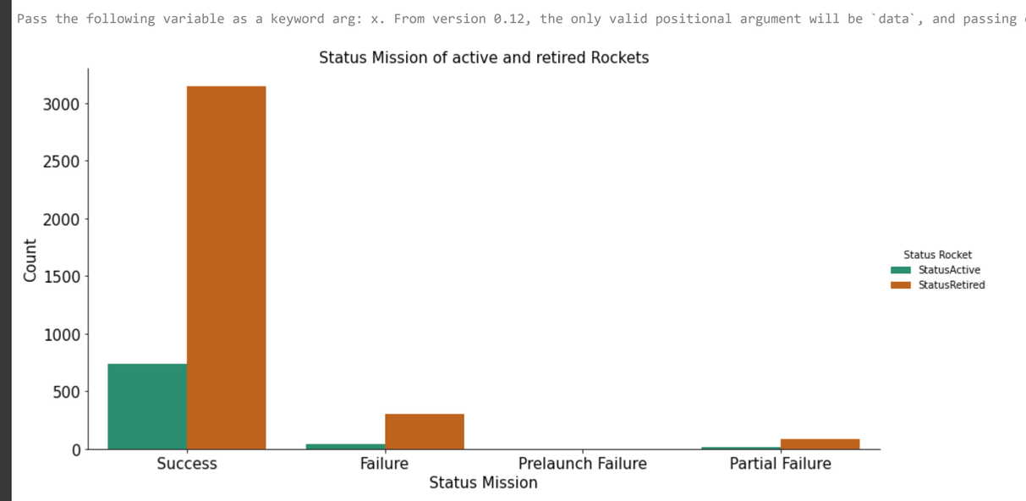


Conclusion: RVSN USSR owns the highest number of rockets

Status Rocket

```
#counting the status mission with respect to active and retired rockets
sns.catplot('Status Mission',kind='count',data=df,hue='Status Rocket',palette='Dark2',height=6,aspect=2)
plt.xticks(size=15)
plt.xlabel('Status Mission',size=15)
plt.yticks(size=15)
plt.ylabel('Count',size=15)
plt.title('Status Mission of active and retired Rockets',size=15)
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning:

Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
```



Conclusion: Retired rockets has highest success rate

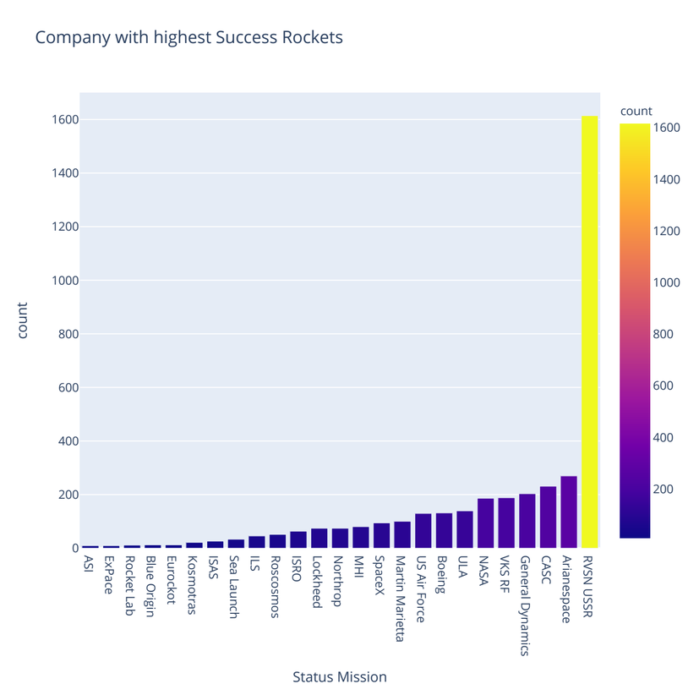
Success Rocket Analysis

```
#success rocket analysis count
success=df[df['Status Mission']=='Success']

data = success['Company Name'].value_counts().reset_index()

data.columns = [
    'Status Mission',
    'count'
]

data = data.sort_values('count')
print(data)
```

```
   Status Mission  count
48        i-Space      1
40     Khrunichev      1
41           IRGC      1
42           KARI      1
47        Starsem      1
44            RAE      1
45         CECLES      1
46             UT      1
43        Douglas      1
35            SRC      2
36       Yuzhmash      2
38           KCST      2
39        OKB-586      2
37        US Navy      2
```

```
34          CASIC      3
33   Arm??e de l'Air      3
32           AMBA      4
31            ISA      4
30           MITT      6
29           JAXA      6
28           CNES      6
27    Land Launch      6
25            ESA      9
26            IAI      9
24            ASI      9
23         ExPace      9
22     Rocket Lab     11
21    Blue Origin     12
20       Eurockot     12
19      Kosmotras     21
18           ISAS     26
17     Sea Launch     33
16            ILS     45
15      Roscosmos     51
14           ISRO     63
13       Lockheed     74
12       Northrop     74
11            MHI     80
10         SpaceX     94
9   Martin Marietta    100
8     US Air Force    129
7          Boeing    131
6             ULA    139
5            NASA    186
4          VKS RF    188
3  General Dynamics    203
2            CASC    231
1     Arianespace    269
0       RVSN USSR   1614
```

```
#success rocket analysis visualization
fig = px.bar(
     data.tail(25),
    y='count',
    x='Status Mission',
    orientation='v',
    title='Company with highest Success Rockets',
    width=700,
    height=700,
    color='count',

)

fig.show()
```

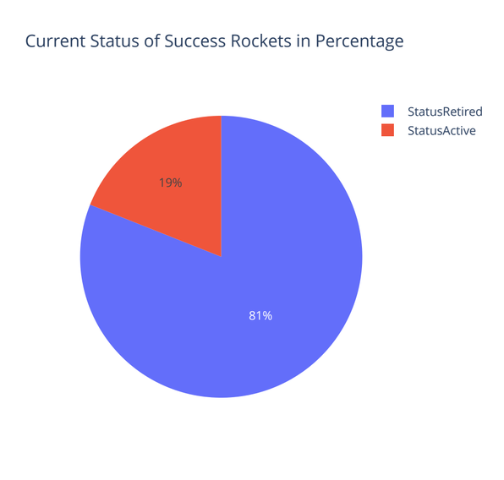


Conclusion: RVSN USSR has highest success rate

```
#To get the current status of successful rockets
data = success['Status Rocket'].value_counts().reset_index()

data.columns = [
    'Status Rocket',
    'count'
]
print(data)
```

```
    Status Rocket  count
0  StatusRetired   3143
1   StatusActive    736
```

```
#To plot the pie chart for the current status of successful rockets
fig = px.pie(
    data,
    values='count',
    names='Status Rocket',
    title='Current Status of Success Rockets in Percentage',
    width=500,
    height=500,
)

fig.show()
```



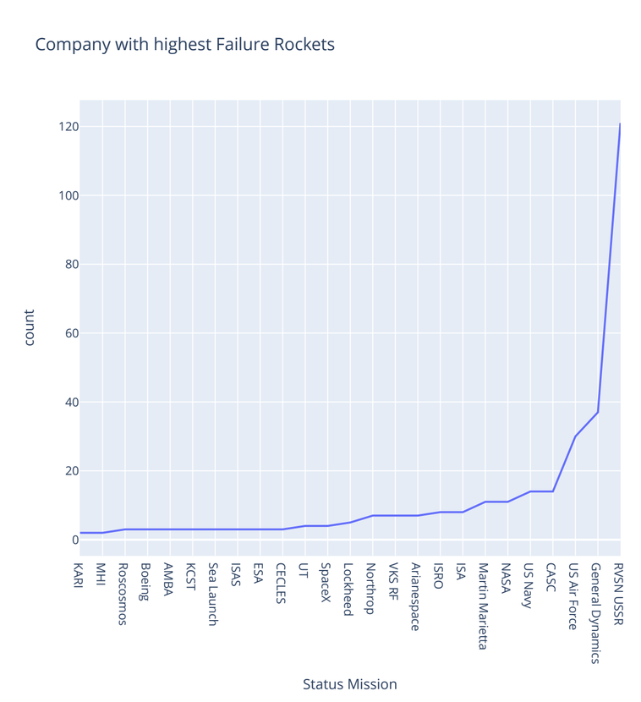
Conclusion: Retired rockets have had highest success while the active rockets have had lesser success

Failure Rocket Analysis

```
#Failure rocket analysis count
Failure=df[df['Status Mission']=='Failure']

data = Failure['Company Name'].value_counts().reset_index()

data.columns = [
    'Status Mission',
    'count'
]

data = data.sort_values('count')
print(data)
```

```
       Status Mission  count
42          ExPace      1
30            JAXA      1
32             SRC      1
33    Virgin Orbit      1
34            Exos      1
35       Landspace      1
31            MITT      1
37       Kosmotras      1
38             RAE      1
39        Eurockot      1
40             EER      1
36        OneSpace      1
41          Sandia      1
29      Rocket Lab      2
28             AEB      2
27            CNES      2
26             IAI      2
25           CASIC      2
24            KARI      2
23             MHI      2
22       Roscosmos      3
21          Boeing      3
19            AMBA      3
18            KCST      3
17      Sea Launch      3
16            ISAS      3
15             ESA      3
20          CECLES      3
14              UT      4
13          SpaceX      4
12        Lockheed      5
9         Northrop      7
11          VKS RF      7
10     Arianespace      7
8             ISRO      8
7              ISA      8
6   Martin Marietta     11
5             NASA     11
4          US Navy     14
3             CASC     14
2     US Air Force     30
1  General Dynamics     37
0        RVSN USSR    121
```

```
# Visualization of failure  rocket using scatter
fig = px.line(
    data.tail(25),
    y='count',
    x='Status Mission',
    title='Company with highest Failure Rockets',
    width=700,
    height=700
)

fig.show()
```

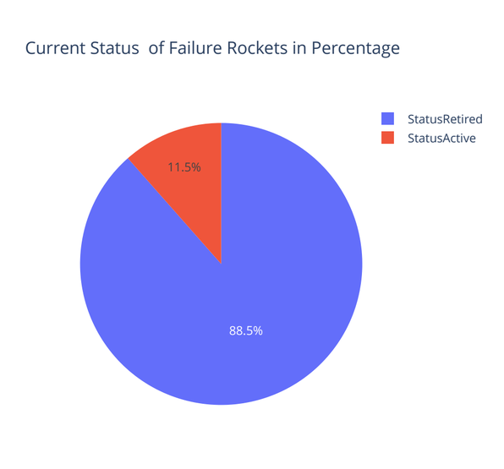


Conclusion: RVSN USSR has highest number of failures

```
#Failure rocket status analysis
data = Failure['Status Rocket'].value_counts().reset_index()

data.columns = [
    'Status Rocket',
    'count'
]
print(data)
```

```
    Status Rocket  count
0  StatusRetired    300
1   StatusActive     39
```

```
#to plot the pie chart for the current status of failure rockets
fig = px.pie(
    data,
    values='count',
    names='Status Rocket',
    title='Current Status  of Failure Rockets in Percentage',
    width=500,
    height=500
)

fig.show()
```



Conclusion: Most Failure Rockets are now Retired

ISRO analysis

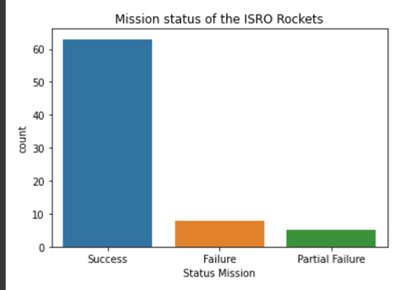
```
# Count Of rockets launched by ISRO
isro=df[df['Company Name']=='ISRO']
print("No Of rockets launched by ISRO",isro.shape[0])
```

```
No Of rockets launched by ISRO 76
```

```
# Status Mission of ISRO Rockets
```

```
sns.countplot(isro['Status Mission'])
plt.title("Mission status of the ISRO Rockets")
plt.show()
```

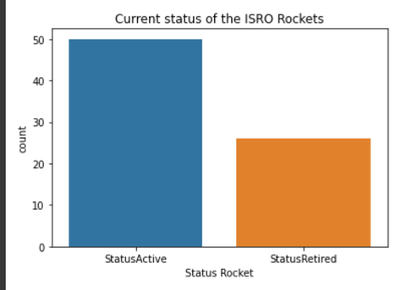
```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning:

Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
```



Conclusion: ISRO has gven more successful space mission than failure

```
# Current Status of ISRO Rockets
sns.countplot(isro['Status Rocket'])
plt.title("Current status of the ISRO Rockets")
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning:

Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
```



Conclusion: Number of active rockets of ISRO is more when compared to retired rockets

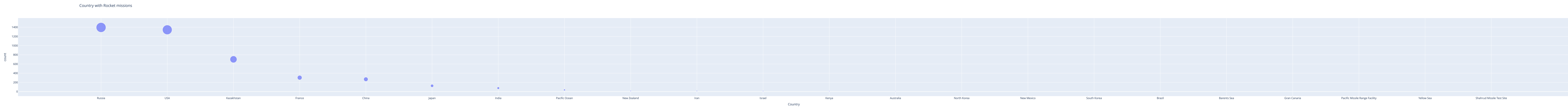
Country Analysis

```
#Extracting Country using the location column
df['country'] = df['Location'].str.split(', ').str[-1]
df['country'].head()
```

```
0          USA
1        China
2          USA
3   Kazakhstan
4          USA
Name: country, dtype: object
```

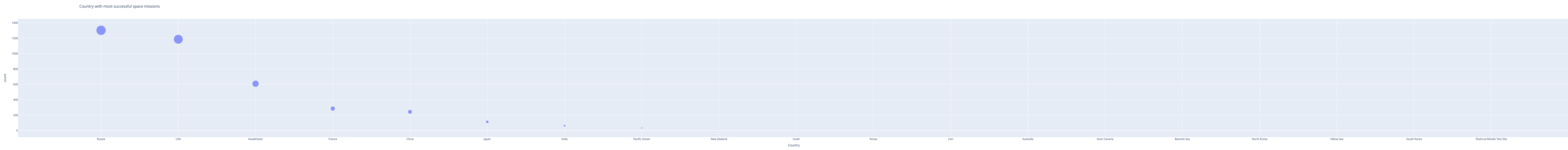
```
# Count of Each country's Rocket Missions
data = df['country'].value_counts().reset_index()

data.columns = [
    'Country',
    'count'
]
```

```
# Countries with Rocket Missions
fig = px.scatter(
     data,
    y='count',
    x='Country',
    title='Country with Rocket missions',
    size='count',
    size_max=30
)
fig.show()
```



Conclusion: Russia has had the highest number of space missions

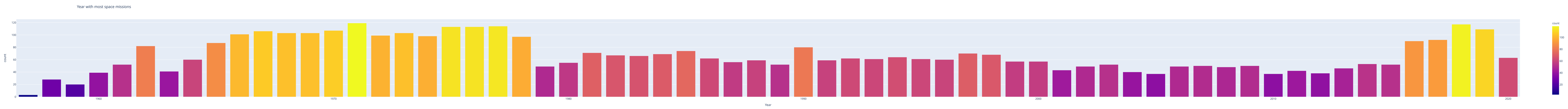
```
#Countries with Successful space missions
Success1=df[df['Status Mission']=='Success']

data = Success1['country'].value_counts().reset_index()

data.columns = [
    'Country',
    'count'
]

fig = px.scatter(
    data,
    y='count',
    x='Country',
    title='Country with most successful space missions',
    height=700,
    size='count',
    size_max=30
)

fig.show()
```



Conclusion: Russia has had the highest number of successful space missions

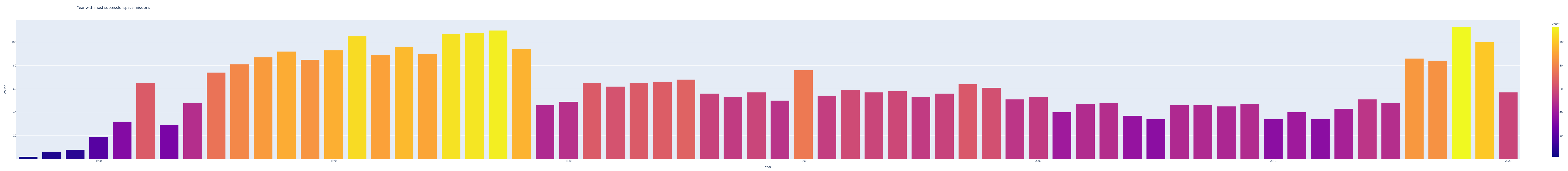
Launch Year

```
# To analyse and plot the number of space mission per year
def get_year(x):
    return x[12:16]
df['Year']=df['Datum'].map(get_year)
df['Year']=df['Year'].astype('int64')

data = df['Year'].value_counts().reset_index()

data.columns = [
    'Year',
    'count'
]

fig = px.bar(
    data,
    y='count',
    x='Year',
    orientation='v',
    title='Year with most space missions',
    color='count'
)

fig.show()
```



Conclusion: 1971 majority of the space missions took place

```
# To analyse and plot the number of successful space mission per year
Success=df[df['Status Mission']=='Success']

data = Success['Year'].value_counts().reset_index()

data.columns = [
    'Year',
    'count'
]

fig = px.bar(
    data,
    y='count',
    x='Year',
    title='Year with most successful space missions',
    height=800,
    color='count'
)

fig.show()
```



Conclusion: In 2018, maximum successful space missions took place

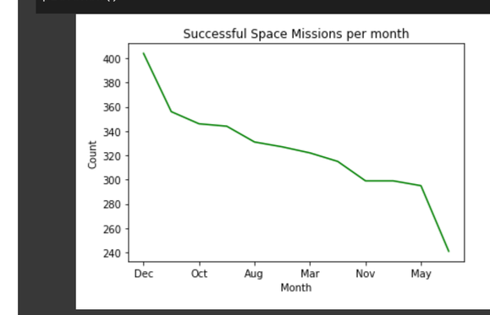
Launch Month

```
# To analyse and plot the number of space mission per month
def get_month(x):
    return x[4:7]
df['Month']=df['Datum'].map(get_month)

data = df['Month'].value_counts().reset_index()
```

```
data.columns = [
    'Month',
    'count'
]

fig = px.line(
    data,
    y='count',
    x='Month',
    title='Month with most space missions',
    height=500)
fig.show()
```

Conclusion: Maximum number of space missions take place in the month of December

```
# To analyse and plot the number of successful space mission per month
Successs=df[df['Status Mission']=='Success']
Successs['Month'].value_counts().plot(kind='line',color='green')
plt.title('Successful Space Missions per month')
plt.xlabel('Month')
plt.ylabel('Count')
plt.show()
```



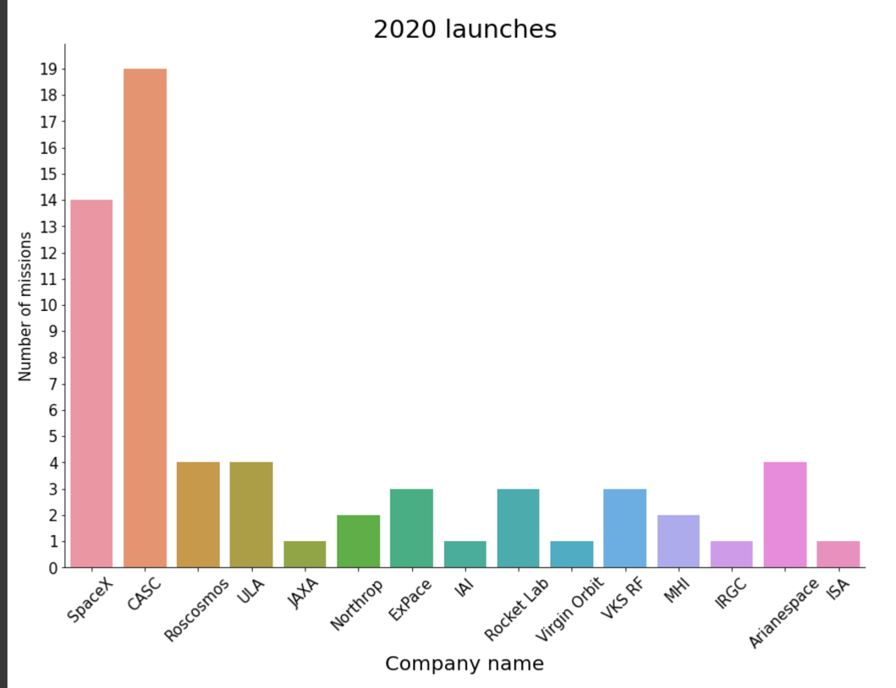
Conclusion: December has seen maximum successful space missions

Latest Launches per company

```
#To get the records of latest launch
df_latest=df[df['Year']==2020]
```

```
# Plot latest launches using categoryplot
sns.catplot('Company Name',data=df_latest,kind='count',height=8,aspect=1.5)
plt.yticks(np.arange(20))
plt.title('2020 launches',size=25)
plt.xlabel('Company name',size=20)
plt.xticks(size=15,rotation=45)
plt.yticks(size=15)
plt.ylabel('Number of missions',size=15)
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning:

Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
```

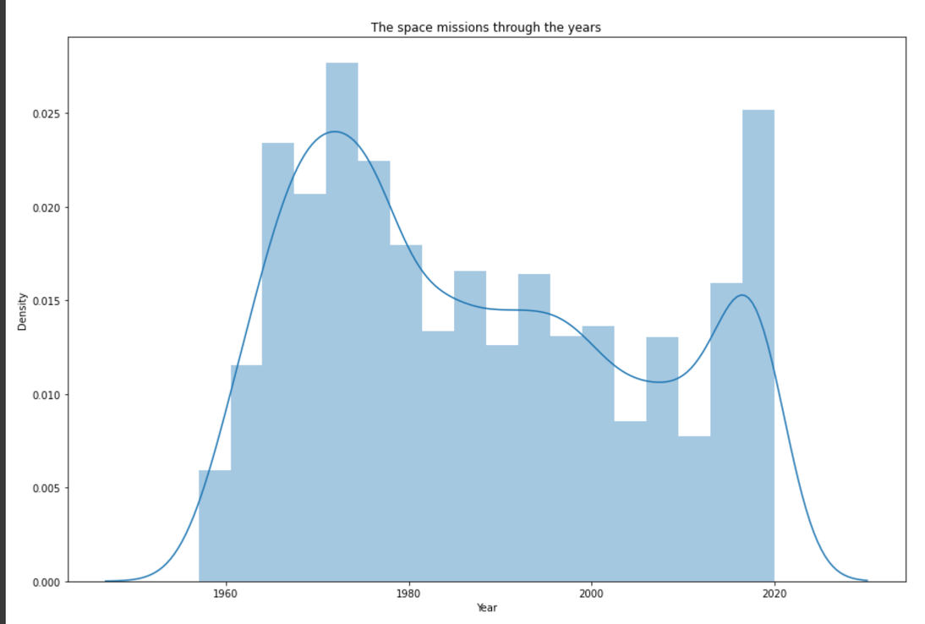


Conclusion: CASC has the maximum latest space missions

The space missions through the years

```
# to plot the space missions through the years
plt.figure(figsize=(15,10))
sns.distplot(df['Year'])
plt.title("The space missions through the years")
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWarning:

`distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
```



PreProcessing

Information of the dataframe

```
# to find the Information of the dataframe#
print("The information of the space dataframe is")
print(df.info())
```

```
The information of the space dataframe is
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4324 entries, 0 to 4323
Data columns (total 12 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   Unnamed: 0      4324 non-null   int64
 1   Unnamed: 0.1    4324 non-null   int64
 2   Company Name    4324 non-null   object
 3   Location        4324 non-null   object
 4   Datum           4324 non-null   object
 5   Detail          4324 non-null   object
 6   Status Rocket   4324 non-null   object
 7    Rocket         964 non-null    object
 8   Status Mission  4324 non-null   object
 9   country         4324 non-null   object
 10  Year            4324 non-null   int64
 11  Month           4324 non-null   object
dtypes: int64(3), object(9)
memory usage: 405.5+ KB
None
```

rows and columns of the dataframe

```
# to find the rows and columns of the dataframe#
print("The number of rows and columns are")
print(df.shape)
```

```
The number of rows and columns are
(4324, 12)
```

columns present in dataframe

```
#To get the columns present in dataframe#
print("The columns present in dataframe is")
print(df.columns)
```

```
The columns present in dataframe is
Index(['Unnamed: 0', 'Unnamed: 0.1', 'Company Name', 'Location', 'Datum',
       'Detail', 'Status Rocket', ' Rocket', 'Status Mission', 'country',
       'Year', 'Month'],
      dtype='object')
```

```
df.drop('Unnamed: 0.1',axis=1,inplace=True) # Dropping Unnamed: 0.1 column since it does not provide any information
df.head()
```

	Unnamed: 0	Company Name	Location	Datum	Detail	Status Rocket	Rocket	Status Mission	country	Year	Month
0	0	SpaceX	LC-39A, Kennedy Space Center, Florida, USA	Fri Aug 07, 2020 05:12 UTC	Falcon 9 Block 5 | Starlink V1 L9 & BlackSky	StatusActive	50.0	Success	USA	2020	Aug
1	1	CASC	Site 9401 (SLS-2), Jiuquan Satellite Launch Ce...	Thu Aug 06, 2020 04:01 UTC	Long March 2D | Gaofen-9 04 & Q-SAT	StatusActive	29.75	Success	China	2020	Aug
2	2	SpaceX	Pad A, Boca Chica, Texas, USA	Tue Aug 04, 2020 23:57 UTC	Starship Prototype | 150 Meter Hop	StatusActive	NaN	Success	USA	2020	Aug
3	3	Roscosmos	Site 200/39, Baikonur Cosmodrome, Kazakhstan	Thu Jul 30, 2020 21:25 UTC	Proton-M/Briz-M | Ekspress-80 & Ekspress-103	StatusActive	65.0	Success	Kazakhstan	2020	Jul
4	4	ULA	SLC-41, Cape Canaveral AFS, Florida, USA	Thu Jul 30, 2020 11:50 UTC	Atlas V 541 | Perseverance	StatusActive	145.0	Success	USA	2020	Jul

```
df.drop('Unnamed: 0',axis=1,inplace=True) # Dropping Unnamed: 0 column since it does not provide any information
df.head()
```

	Company Name	Location	Datum	Detail	Status Rocket	Rocket	Status Mission	country	Year	Month
0	SpaceX	LC-39A, Kennedy Space Center, Florida, USA	Fri Aug 07, 2020 05:12 UTC	Falcon 9 Block 5 | Starlink V1 L9 & BlackSky	StatusActive	50.0	Success	USA	2020	Aug
1	CASC	Site 9401 (SLS-2), Jiuquan Satellite Launch Ce...	Thu Aug 06, 2020 04:01 UTC	Long March 2D | Gaofen-9 04 & Q-SAT	StatusActive	29.75	Success	China	2020	Aug
2	SpaceX	Pad A, Boca Chica, Texas, USA	Tue Aug 04, 2020 23:57 UTC	Starship Prototype | 150 Meter Hop	StatusActive	NaN	Success	USA	2020	Aug
3	Roscosmos	Site 200/39, Baikonur Cosmodrome, Kazakhstan	Thu Jul 30, 2020 21:25 UTC	Proton-M/Briz-M | Ekspress-80 & Ekspress-103	StatusActive	65.0	Success	Kazakhstan	2020	Jul
4	ULA	SLC-41, Cape Canaveral AFS, Florida, USA	Thu Jul 30, 2020 11:50 UTC	Atlas V 541 | Perseverance	StatusActive	145.0	Success	USA	2020	Jul

Descriptive statistics of the dataframe

```
#To print the descriptive statistics of the dataframe#
print("The descriptive statistics of the dataframe is")
df.describe()
```

The descriptive statistics of the dataframe is

	Year
count	4324.000000
mean	1987.386679
std	18.072562
min	1957.000000
25%	1972.000000
50%	1984.000000
75%	2002.000000
max	2020.000000

value count of mission status column

```
#To get the value count of mission status column#
print("The value count of mission status column in the dataset is")
df["Status Mission"].value_counts()
```

```
The value count of mission status column in the dataset is
Success              3879
Failure               339
Partial Failure       102
Prelaunch Failure       4
Name: Status Mission, dtype: int64
```

Null values in the dataframe

```
# To find any null values in the dataframe#
df.isna().any()
```

```
Company Name      False
Location          False
Datum             False
Detail            False
Status Rocket     False
Rocket            False
Status Mission    False
country           False
Year              False
Month             False
dtype: bool
```

Number of null values in Rocket column of the dataframe

```
# To find the number of null values in Rocket column of the dataframe
df['  Rocket'].isna().value_counts()
```

```
True     3360
False     964
Name:  Rocket, dtype: int64
```

```
df.drop(' Rocket',axis=1,inplace=True) # Dropping Rocket since it contains lots of null values
df.head()
```

	Company Name	Location	Datum	Detail	Status Rocket	Status Mission	country	Year	Month
0	SpaceX	LC-39A, Kennedy Space Center, Florida, USA	Fri Aug 07, 2020 05:12 UTC	Falcon 9 Block 5	Starlink V1 L9 & BlackSky	StatusActive	Success	USA	2020	Aug
1	CASC	Site 9401 (SLS-2), Jiuquan Satellite Launch Ce...	Thu Aug 06, 2020 04:01 UTC	Long March 2D	Gaofen-9 04 & Q-SAT	StatusActive	Success	China	2020	Aug
2	SpaceX	Pad A, Boca China, Texas, USA	Tue Aug 04, 2020 23:57 UTC	Starship Prototype	150 Meter Hop	StatusActive	Success	USA	2020	Aug
3	Roscosmos	Site 200/39, Baikonur Cosmodrome, Kazakhstan	Thu Jul 30, 2020 21:25 UTC	Proton-M/Briz-M	Ekspress-80 & Ekspress-103	StatusActive	Success	Kazakhstan	2020	Jul
4	ULA	SLC-41, Cape Canaveral AFS, Florida, USA	Thu Jul 30, 2020 11:50 UTC	Atlas V 541	Perseverance	StatusActive	Success	USA	2020	Jul

Datatype of all the columns in the dataframe

```
# To find the datatype of all the columns in the dataframe
df.dtypes
```

```
Company Name      object
Location          object
Datum             object
Detail            object
Status Rocket     object
Status Mission    object
country           object
Year               int64
Month             object
dtype: object
```

Remove the word Status in Status Rocket column Values

```
# To change the Status Rocket column values from StatusActive to Active by removing the word Status
df['Status Rocket']=df['Status Rocket'].str.replace('Status','')
print(df['Status Rocket'])
```

```
0       Active
1       Active
2       Active
3       Active
4       Active
        ...
4319    Retired
4320    Retired
4321    Retired
4322    Retired
4323    Retired
Name: Status Rocket, Length: 4324, dtype: object
```