SPACE MISSION ANALYSIS SINCE COLD WAR

Step1: Importing Necessary Languages.

In [64]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

import plotly.express as px
import iso3166 as iso
from datetime import datetime, timedelta
```

Step2: Some Improvements.

In [14]:
```
%pip install iso3166
```

```
Requirement already satisfied: iso3166 in c:\users\admin\anaconda3\lib\site-packages (2.1.1)
Note: you may need to restart the kernel to use updated packages.
```

In [15]:
```
%pip install --upgrade plotly
```

```
Requirement already satisfied: plotly in c:\users\admin\anaconda3\lib\site-packages (5.15.0)
Requirement already satisfied: tenacity>=6.2.0 in c:\users\admin\anaconda3\lib\site-packages (from plotly) (8.0
.1)
Requirement already satisfied: packaging in c:\users\admin\anaconda3\lib\site-packages (from plotly) (22.0)
Note: you may need to restart the kernel to use updated packages.
```

In [16]:
```
pip install seaborn
```

```
Requirement already satisfied: seaborn in c:\users\admin\anaconda3\lib\site-packages (0.12.2)
Requirement already satisfied: pandas>=0.25 in c:\users\admin\anaconda3\lib\site-packages (from seaborn) (1.5.3
)
Requirement already satisfied: matplotlib!=3.6.1,>=3.1 in c:\users\admin\anaconda3\lib\site-packages (from seab
orn) (3.7.0)
Requirement already satisfied: numpy!=1.24.0,>=1.17 in c:\users\admin\anaconda3\lib\site-packages (from seaborn
) (1.23.5)
Requirement already satisfied: cycler>=0.10 in c:\users\admin\anaconda3\lib\site-packages (from matplotlib!=3.6
.1,>=3.1->seaborn) (0.11.0)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\admin\anaconda3\lib\site-packages (from matplotlib
!=3.6.1,>=3.1->seaborn) (1.4.4)
Requirement already satisfied: python-dateutil>=2.7 in c:\users\admin\anaconda3\lib\site-packages (from matplot
lib!=3.6.1,>=3.1->seaborn) (2.8.2)
Requirement already satisfied: pyparsing>=2.3.1 in c:\users\admin\anaconda3\lib\site-packages (from matplotlib!
=3.6.1,>=3.1->seaborn) (3.0.9)
Requirement already satisfied: fonttools>=4.22.0 in c:\users\admin\anaconda3\lib\site-packages (from matplotlib
!=3.6.1,>=3.1->seaborn) (4.25.0)
Requirement already satisfied: packaging>=20.0 in c:\users\admin\anaconda3\lib\site-packages (from matplotlib!=
3.6.1,>=3.1->seaborn) (22.0)
Requirement already satisfied: contourpy>=1.0.1 in c:\users\admin\anaconda3\lib\site-packages (from matplotlib!
=3.6.1,>=3.1->seaborn) (1.0.5)
Requirement already satisfied: pillow>=6.2.0 in c:\users\admin\anaconda3\lib\site-packages (from matplotlib!=3.
6.1,>=3.1->seaborn) (9.4.0)
Requirement already satisfied: pytz>=2020.1 in c:\users\admin\anaconda3\lib\site-packages (from pandas>=0.25->s
eaborn) (2022.7)
Requirement already satisfied: six>=1.5 in c:\users\admin\anaconda3\lib\site-packages (from python-dateutil>=2.
7->matplotlib!=3.6.1,>=3.1->seaborn) (1.16.0)
Note: you may need to restart the kernel to use updated packages.
```

In [17]:
```
pip install iso3166
```

```
Requirement already satisfied: iso3166 in c:\users\admin\anaconda3\lib\site-packages (2.1.1)
Note: you may need to restart the kernel to use updated packages.
```

In [18]:
```
pip install country_converter --upgrade
```

```
Requirement already satisfied: country_converter in c:\users\admin\anaconda3\lib\site-packages (1.0.0)
Requirement already satisfied: pandas>=1.0 in c:\users\admin\anaconda3\lib\site-packages (from country_converte
r) (1.5.3)
Requirement already satisfied: python-dateutil>=2.8.1 in c:\users\admin\anaconda3\lib\site-packages (from panda
s>=1.0->country_converter) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in c:\users\admin\anaconda3\lib\site-packages (from pandas>=1.0->co
untry_converter) (2022.7)
Requirement already satisfied: numpy>=1.21.0 in c:\users\admin\anaconda3\lib\site-packages (from pandas>=1.0->c
ountry_converter) (1.23.5)
Requirement already satisfied: six>=1.5 in c:\users\admin\anaconda3\lib\site-packages (from python-dateutil>=2.
8.1->pandas>=1.0->country_converter) (1.16.0)
Note: you may need to restart the kernel to use updated packages.
```

In [19]:
```
pip install pandas
```

```
Requirement already satisfied: pandas in c:\users\admin\anaconda3\lib\site-packages (1.5.3)
Requirement already satisfied: pytz>=2020.1 in c:\users\admin\anaconda3\lib\site-packages (from pandas) (2022.7
)
Requirement already satisfied: python-dateutil>=2.8.1 in c:\users\admin\anaconda3\lib\site-packages (from panda
s) (2.8.2)
Requirement already satisfied: numpy>=1.21.0 in c:\users\admin\anaconda3\lib\site-packages (from pandas) (1.23.
5)
Requirement already satisfied: six>=1.5 in c:\users\admin\anaconda3\lib\site-packages (from python-dateutil>=2.
8.1->pandas) (1.16.0)
Note: you may need to restart the kernel to use updated packages.
```

In [65]:
```
pd.options.display.float_format = '{:,.2f}'.format
```

Step3: Importing Data.

In [68]:
```
file_path = "C:\\Users\\Admin\\Desktop\\data_analysis\\mission_launches.csv"
```

In [67]:
```
df = pd.read_csv(file_path)
df.head()
```

Out[67]:

	Unnamed: 0.1	Unnamed: 0	Organisation	Location	Date	Detail	Rocket_Status	Price	Mission_Status
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

Step4: Checking Number of Rows and Columns

In [23]:
```
df.shape
```

Out[23]:
```
(4324, 9)
```

In [24]:
```
count_row = df.shape[0]
count_col = df.shape[1]
print("There are",count_row, "rows and",count_col, "columns in this data.")
```

```
There are 4324 rows and 9 columns in this data.
```

In [25]:
```
print("The column names are as follows:",df.columns)
```

```
The column names are as follows: Index(['Unnamed: 0.1', 'Unnamed: 0', 'Organisation', 'Location', 'Date',
       'Detail', 'Rocket_Status', 'Price', 'Mission_Status'],
      dtype='object')
```

In [26]:
```
df.isna()
```

Out[26]:

	Unnamed: 0.1	Unnamed: 0	Organisation	Location	Date	Detail	Rocket_Status	Price	Mission_Status
0	False	False	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False	True	False
3	False	False	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False	False	False
...	...	...	...	...	...	...	...	...	...
4319	False	False	False	False	False	False	False	True	False
4320	False	False	False	False	False	False	False	True	False
4321	False	False	False	False	False	False	False	True	False
4322	False	False	False	False	False	False	False	True	False
4323	False	False	False	False	False	False	False	True	False

4324 rows × 9 columns

Checking for Missing Values

In [27]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4324 entries, 0 to 4323
Data columns (total 9 columns):
 #   Column          Non-Null Count  Dtype 
---  ------          --------------  ----- 
 0   Unnamed: 0.1    4324 non-null   int64 
 1   Unnamed: 0      4324 non-null   int64 
 2   Organisation    4324 non-null   object
 3   Location        4324 non-null   object
 4   Date            4324 non-null   object
 5   Detail          4324 non-null   object
 6   Rocket_Status   4324 non-null   object
 7   Price           964 non-null    object
 8   Mission_Status  4324 non-null   object
dtypes: int64(2), object(7)
memory usage: 304.2+ KB
```

Checking for Missing Values and Duplicates

In [28]:
```
clean_df = df.dropna()
```

In [29]:
```
df.drop(columns=['Unnamed: 0', 'Unnamed: 0.1'], inplace=True)
df.head()
```

Out[29]:

	Organisation	Location	Date	Detail	Rocket_Status	Price	Mission_Status
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	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	SpaceX	Pad A, Boca Chica, Texas, USA	Tue Aug 04, 2020 23:57 UTC	Starship Prototype | 150 Meter Hop	StatusActive	NaN	Success
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	ULA	SLC-41, Cape Canaveral AFS, Florida, USA	Thu Jul 30, 2020 11:50 UTC	Atlas V 541 | Perseverance	StatusActive	145.0	Success

Checking Discriptive Statistics

In [30]:
```
df.describe()
```

Out[30]:

	Organisation	Location	Date	Detail	Rocket_Status	Price	Mission_Status
count	4324	4324	4324	4324	4324	964	4324
unique	56	137	4319	4278	2	56	4
top	RVSN USSR	Site 31/6, Baikonur Cosmodrome, Kazakhstan	Wed Nov 05, 2008 00:15 UTC	Cosmos-3MRB (65MRB) | BOR-5 Shuttle	StatusRetired	450.0	Success
freq	1777	235	2	6	3534	136	3879

In [31]:
```
print(df.Organisation.value_counts(),
      df.Location.value_counts(),
      df.Date.value_counts(),
      df.Detail.value_counts(),
      df.Rocket_Status.value_counts(),
      df.Price.value_counts(),
      df.Mission_Status.value_counts())
```

```
RVSN USSR            1777
Arianespace           279
CASC                  251
General Dynamics      251
NASA                  203
VKS RF                201
US Air Force          161
ULA                   140
Boeing                136
Martin Marietta       114
SpaceX                100
MHI                    84
Northrop               83
Lockheed               79
ISRO                   76
Roscosmos              55
ILS                    46
Sea Launch             36
ISAS                   30
Kosmotras              22
US Navy                17
ISA                    13
Rocket Lab             13
Eurockot               13
ESA                    13
Blue Origin            12
IAI                    11
ExPace                 10
ASI                     9
CNES                    8
AMBA                    8
MITT                    7
JAXA                    7
Land Launch             7
UT                      5
KCST                    5
CASIC                   5
Exos                    4
CECLES                  4
Arm??e de l'Air         4
KARI                    3
SRC                     3
AEB                     3
RAE                     2
OKB-586                 2
Yuzhmash                2
Landspace               1
Douglas                 1
EER                     1
Starsem                 1
Virgin Orbit            1
IRGC                    1
i-Space                 1
OneSpace                1
Sandia                  1
Khrunichev              1
Name: Organisation, dtype: int64 Site 31/6, Baikonur Cosmodrome, Kazakhstan               235
Site 132/1, Plesetsk Cosmodrome, Russia                  216
Site 43/4, Plesetsk Cosmodrome, Russia                   202
Site 41/1, Plesetsk Cosmodrome, Russia                   198
Site 1/5, Baikonur Cosmodrome, Kazakhstan                193
                                                        ...
Jiuquan Satellite Launch Center, China                     1
LP-41, Kauai, Pacific Missile Range Facility               1
Tai Rui Barge, Yellow Sea                                  1
Launch Plateform, Shahrud Missile Test Site                1
K-496 Submarine, Barents Sea Launch Area, Barents Sea      1
Name: Location, Length: 137, dtype: int64 Wed Nov 05, 2008 00:15 UTC    2
Sun Aug 25, 1991 08:40 UTC    2
Tue Aug 28, 1990 09:05 UTC    2
```

```
Wed Feb 07, 1990 01:33 UTC    2
Tue Jun 26, 1973              2
                             ..
Thu May 16, 1996 01:56 UTC    1
Sun May 12, 1996 21:32 UTC    1
Tue Apr 30, 1996 04:31 UTC    1
Wed Apr 24, 1996 23:37 UTC    1
Fri Oct 04, 1957 19:28 UTC    1
Name: Date, Length: 4319, dtype: int64 Cosmos-3MRB (65MRB) | BOR-5 Shuttle    6
Lambda-IV S | Osumi                    5
Titan IV(402)B | DSP                   5
Titan IIID | KH-11                    5
Proton K/Block D | Zond                4
                                      ..
Ariane 44P | Intelsat 709              1
Ariane 5 G | Cluster                   1
Delta II 7925 | Galaxy 9               1
Space Shuttle Endeavour | STS-77       1
Sputnik 8K71PS | Sputnik-1             1
Name: Detail, Length: 4278, dtype: int64 StatusRetired    3534
StatusActive      790
Name: Rocket_Status, dtype: int64 450.0      136
200.0       75
40.0        55
62.0        41
30.8        38
109.0       37
50.0        34
64.68       34
29.75       33
90.0        32
41.8        31
48.5        26
29.15       25
31.0        22
29.0        22
59.0        22
69.7        17
21.0        16
65.0        16
35.0        16
56.5        15
37.0        15
164.0       15
7.5         14
1,160.0     13
47.0        13
25.0        12
350.0       11
153.0       11
45.0        10
112.5        9
5.3          9
123.0        8
145.0        7
85.0         7
120.0        7
80.0         7
115.0        6
59.5         5
7.0          5
46.0         5
136.6        4
63.23        4
140.0        3
133.0        3
190.0        3
130.0        3
135.0        2
5,000.0      2
39.0         2
55.0         1
15.0         1
20.14        1
20.0         1
12.0         1
28.3         1
Name: Price, dtype: int64 Success              3879
Failure                339
Partial Failure        102
Prelaunch Failure        4
Name: Mission_Status, dtype: int64
```

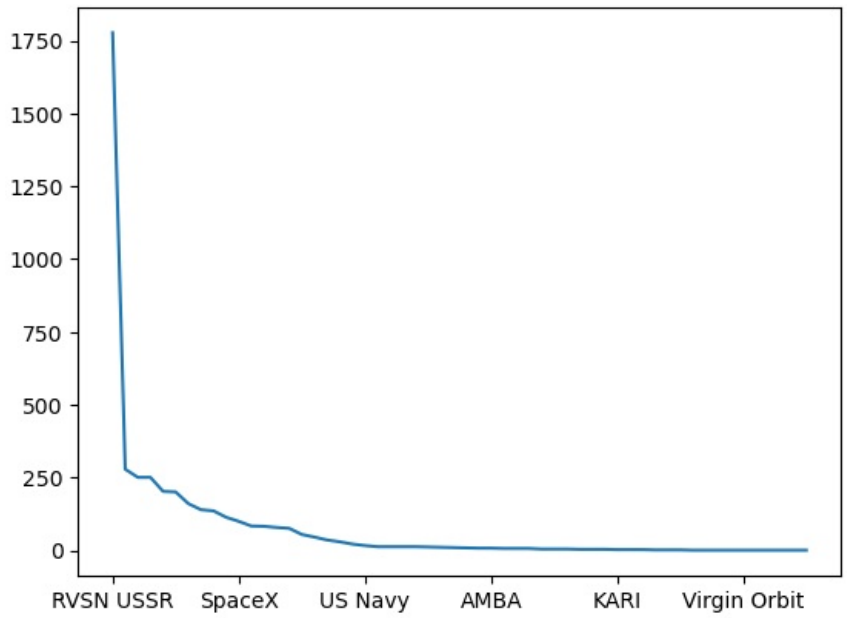
In [32]:
```
df[df["Price"].notna()]["Price"].str.replace(',', '').astype(float).describe()
```

Out[32]:
```
count     964.000000
mean      153.792199
std       288.450732
min         5.300000
25%        40.000000
50%        62.000000
75%       164.000000
max      5000.000000
Name: Price, dtype: float64
```

Comparison of Launches per Company until Today

In [33]:
```
df["Organisation"].value_counts().plot()
```

Out[33]:
```
<Axes: >
```



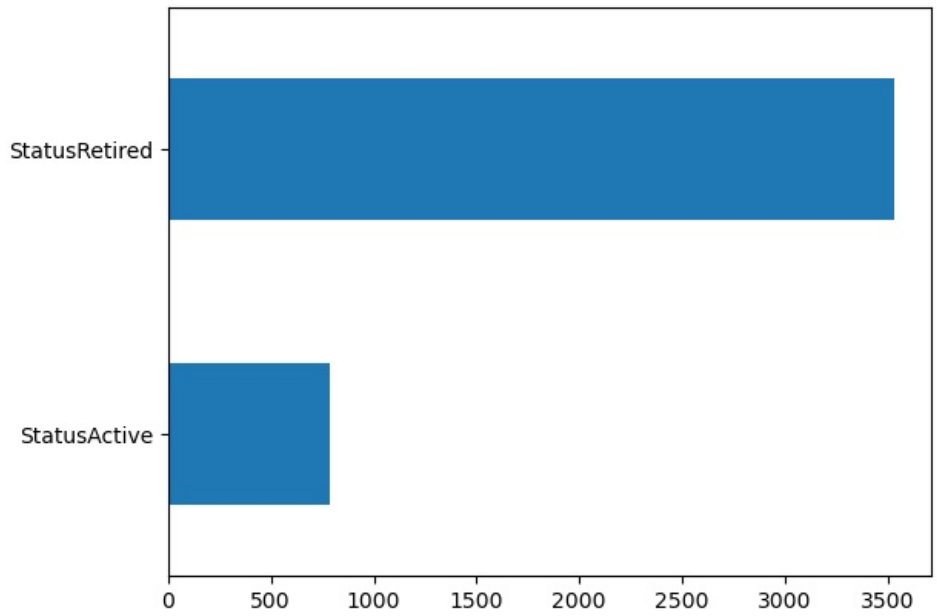
Comparison of Active versus Retired Rockets

In [34]:
```
df["Rocket_Status"].value_counts()
```

Out[34]:
```
StatusRetired    3534
StatusActive      790
Name: Rocket_Status, dtype: int64
```

In [35]:
```
df["Rocket_Status"].value_counts().sort_values().plot(kind="barh")
```

Out[35]:
```
<Axes: >
```



Overall Distribution of Mission Status

In [36]:
```
df["Mission_Status"].value_counts()
```

Out[36]:
```
Success              3879
Failure               339
Partial Failure       102
Prelaunch Failure       4
Name: Mission_Status, dtype: int64
```

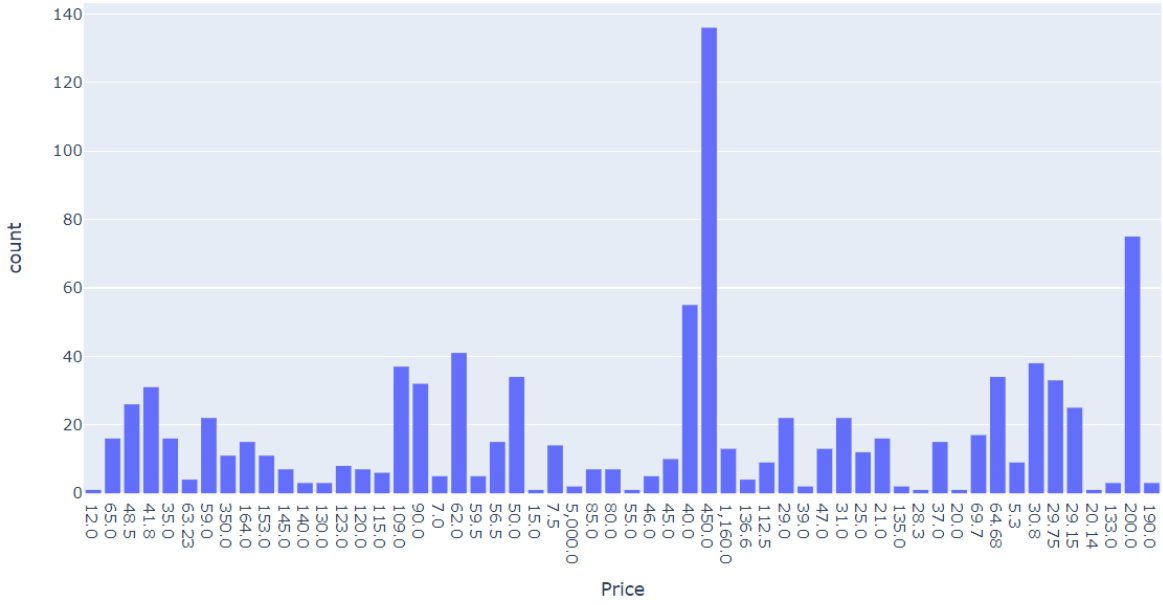
In [37]:
```
df.groupby("Mission_Status").agg({"Mission_Status":pd.Series.count})
```

Out[37]:

Mission_Status	Mission_Status
Failure	339
Partial Failure	102
Prelaunch Failure	4
Success	3879

Cost Comparison of the Launches

In [39]:
```
px.histogram(df.sort_values(by=["Organisation", "Price"], ascending=[False, False]), x="Price",nbins=10)
```



Number of Launches by Country

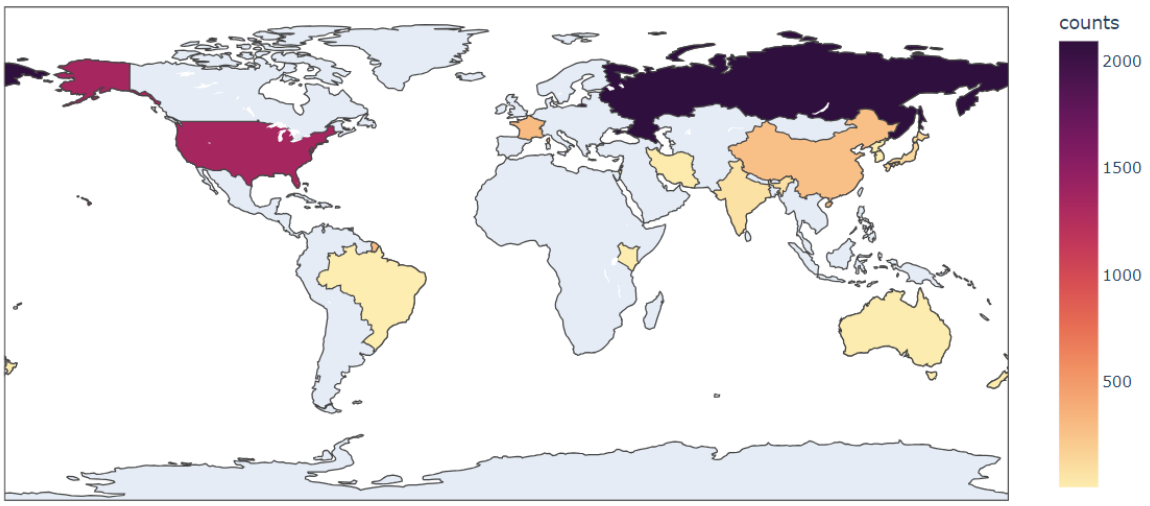
In [40]:
```
df["Country"] = df["Location"].str.split(", ").str[-1]

df.loc[(df["Country"] == 'Russia'), "Country"] = "Russian Federation"
df.loc[(df["Country"] == 'New Mexico'), "Country"] = "USA"
df.loc[(df["Country"] == 'Yellow Sea'), "Country"] = "China"
df.loc[(df["Country"] == 'Shahrud Missile Test Site'), "Country"] = "Iran"
df.loc[(df["Country"] == 'Pacific Missile Range Facility'), "Country"] = "USA"
df.loc[(df["Country"] == 'Barents Sea'), "Country"] = "Russian Federation"
df.loc[(df["Country"] == 'Gran Canaria'), "Country"] = "USA"
df.loc[(df["Country"] == 'Iran'), "Country"] = "Iran, Islamic Republic of"
df.loc[(df["Country"] == 'South Korea'), "Country"] = "Korea, Republic of"
df.loc[(df["Country"] == 'North Korea'), "Country"] = "Korea, Democratic People's Republic of"
df.loc[(df["Country"] == 'Kazakhstan'), "Country"] = "Russian Federation"
```

```
countries = {country.name: key for key, country in iso.countries_by_alpha3.items()}
df = df.replace({"Country": countries})

launches = df["Country"].value_counts().rename_axis("Country").reset_index(name='counts')
launches.head()

world_map = px.choropleth(launches, locations="Country", color="counts", color_continuous_scale=px.colors.seque
world_map.update_layout(coloraxis_showscale=True)
world_map.show()
df.head()
```



Out[40]:

	Organisation	Location	Date	Detail	Rocket_Status	Price	Mission_Status	Country
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
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	CHN
2	SpaceX	Pad A, Boca Chica, Texas, USA	Tue Aug 04, 2020 23:57 UTC	Starship Prototype | 150 Meter Hop	StatusActive	NaN	Success	USA
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	RUS
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

In [41]:

```
for c in countries:
    print(c)
```

```
Afghanistan
Åland Islands
Albania
Algeria
American Samoa
Andorra
Angola
Anguilla
Antarctica
Antigua and Barbuda
Argentina
Armenia
Aruba
Australia
Austria
Azerbaijan
Bahamas
Bahrain
Bangladesh
Barbados
Belarus
Belgium
Belize
Benin
Bermuda
```

Bhutan
Bolivia, Plurinational State of
Bonaire, Sint Eustatius and Saba
Bosnia and Herzegovina
Botswana
Bouvet Island
Brazil
British Indian Ocean Territory
Brunei Darussalam
Bulgaria
Burkina Faso
Burundi
Cambodia
Cameroon
Canada
Cabo Verde
Cayman Islands
Central African Republic
Chad
Chile
China
Christmas Island
Cocos (Keeling) Islands
Colombia
Comoros
Congo
Congo, Democratic Republic of the
Cook Islands
Costa Rica
Côte d'Ivoire
Croatia
Cuba
Curaçao
Cyprus
Czechia
Denmark
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Eritrea
Estonia
Ethiopia
Falkland Islands (Malvinas)
Faroe Islands
Fiji
Finland
France
French Guiana
French Polynesia
French Southern Territories
Gabon
Gambia
Georgia
Germany
Ghana
Gibraltar
Greece
Greenland
Grenada
Guadeloupe
Guam
Guatemala
Guernsey
Guinea
Guinea-Bissau
Guyana
Haiti
Heard Island and McDonald Islands
Holy See
Honduras
Hong Kong
Hungary
Iceland
India
Indonesia
Iran, Islamic Republic of
Iraq
Ireland
Isle of Man
Israel
Italy
Jamaica
Japan
Jersey
Jordan

Kazakhstan
Kenya
Kiribati
Korea, Democratic People's Republic of
Korea, Republic of
Kosovo
Kuwait
Kyrgyzstan
Lao People's Democratic Republic
Latvia
Lebanon
Lesotho
Liberia
Libya
Liechtenstein
Lithuania
Luxembourg
Macao
North Macedonia
Madagascar
Malawi
Malaysia
Maldives
Mali
Malta
Marshall Islands
Martinique
Mauritania
Mauritius
Mayotte
Mexico
Micronesia, Federated States of
Moldova, Republic of
Monaco
Mongolia
Montenegro
Montserrat
Morocco
Mozambique
Myanmar
Namibia
Nauru
Nepal
Netherlands
New Caledonia
New Zealand
Nicaragua
Niger
Nigeria
Niue
Norfolk Island
Northern Mariana Islands
Norway
Oman
Pakistan
Palau
Palestine, State of
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Pitcairn
Poland
Portugal
Puerto Rico
Qatar
Réunion
Romania
Russian Federation
Rwanda
Saint Barthélemy
Saint Helena, Ascension and Tristan da Cunha
Saint Kitts and Nevis
Saint Lucia
Saint Martin (French part)
Saint Pierre and Miquelon
Saint Vincent and the Grenadines
Samoa
San Marino
Sao Tome and Principe
Saudi Arabia
Senegal
Serbia
Seychelles
Sierra Leone
Singapore
Sint Maarten (Dutch part)
Slovakia

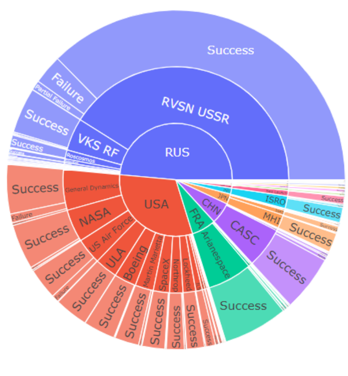
```
Slovenia
Solomon Islands
Somalia
South Africa
South Georgia and the South Sandwich Islands
South Sudan
Spain
Sri Lanka
Sudan
Suriname
Svalbard and Jan Mayen
Eswatini
Sweden
Switzerland
Syrian Arab Republic
Taiwan, Province of China
Tajikistan
Tanzania, United Republic of
Thailand
Timor-Leste
Togo
Tokelau
Tonga
Trinidad and Tobago
Tunisia
Türkiye
Turkmenistan
Turks and Caicos Islands
Tuvalu
Uganda
Ukraine
United Arab Emirates
United Kingdom of Great Britain and Northern Ireland
United States of America
United States Minor Outlying Islands
Uruguay
Uzbekistan
Vanuatu
Venezuela, Bolivarian Republic of
Viet Nam
Virgin Islands, British
Virgin Islands, U.S.
Wallis and Futuna
Western Sahara
Yemen
Zambia
Zimbabwe
```

General Overview of Countries, Organisations, and Mission Status

In [46]:

```
sunburst_graph = df.groupby(by=["Country", "Organisation", "Mission_Status"], as_index=False).size()
sunburst_graph = sunburst_graph.sort_values("size", ascending=False)
sunburst_graph.head()
px.sunburst(sunburst_graph, path=["Country", "Organisation", "Mission_Status"], values="size", title="Missions
```

Missions By Country



Total Amount of Money Spent by Organisation until Today

In [79]:
```
money_spent = df[df["Price"].notna()]

money_spent["Price"] = money_spent["Price"].str.replace(',', '').astype(float)

total_money_spent = money_spent.groupby("Organisation")["Price"].sum().reset_index()
total_money_spent.sort_values(by="Price", ascending=False)
total_money_spent.head()
```

Out[79]:

	Organisation	Price
0	Arianespace	16,345.00
1	Boeing	1,241.00
2	CASC	6,340.26
3	EER	20.00
4	ESA	37.00

Total Cost of per Launch by Organisation

In [78]:
```
organisation_expense = money_spent.groupby("Organisation")["Price"].mean().reset_index()
organisation_expense.sort_values("Price", ascending=False)
organisation_expense.head()
```

Out[78]:

	Organisation	Price
0	Arianespace	170.26
1	Boeing	177.29
2	CASC	40.13
3	EER	20.00
4	ESA	37.00

Number of Launches per Year since 1957

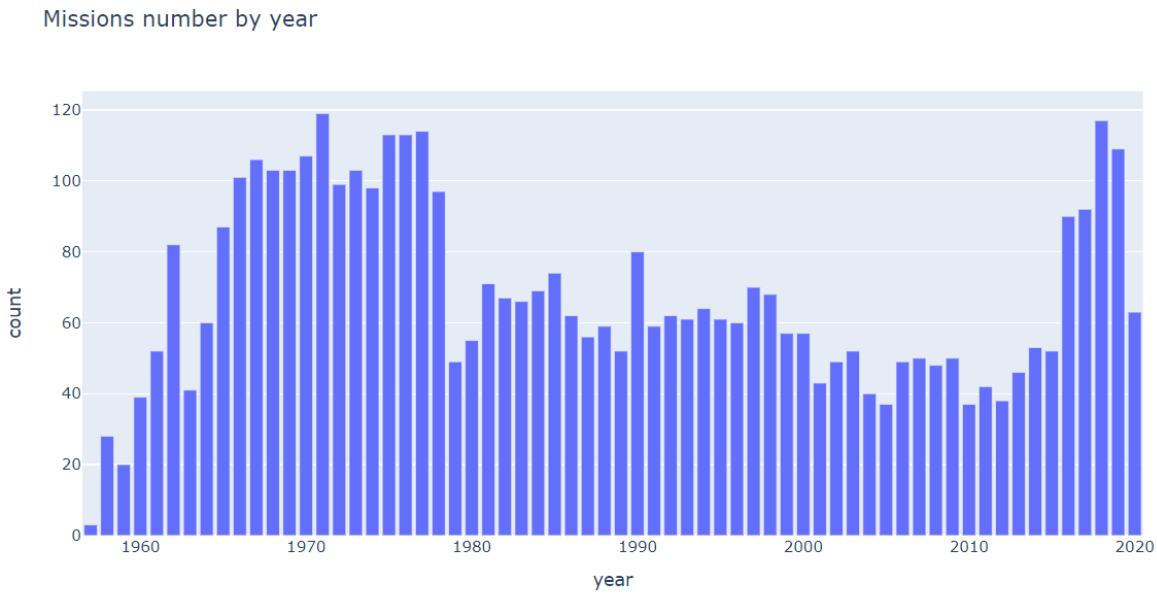
In [48]:
```
df['date'] = pd.to_datetime(df['Date'])
df['year'] = df['date'].apply(lambda datetime: datetime.year)

date = df['year'].value_counts().reset_index()
date.columns = [
```

```
    'year',
    'count']

fig = px.bar(
    date,
    x='year',
    y="count",
    orientation='v',
    title='Missions number by year')

fig.show()
```



Total Number of Launches Month-on-Month until the Present

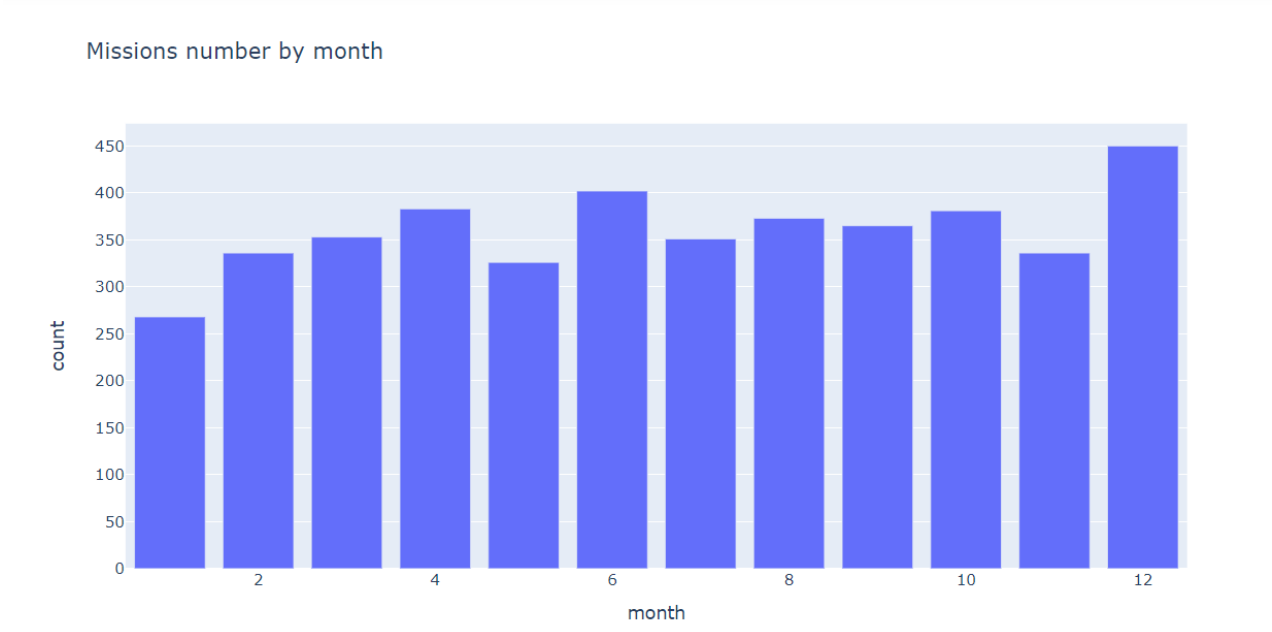
In [49]:

```
df['date'] = pd.to_datetime(df['Date'])
df['month'] = df['date'].apply(lambda datetime: datetime.month)

ds = df['month'].value_counts().reset_index()
ds.columns = [
    'month',
    'count'
]

fig = px.bar(
    ds,
    x='month',
    y="count",
    orientation='v',
    title='Missions number by month'

)
fig.show()
```



Lauch Cost Fluctuation over Years

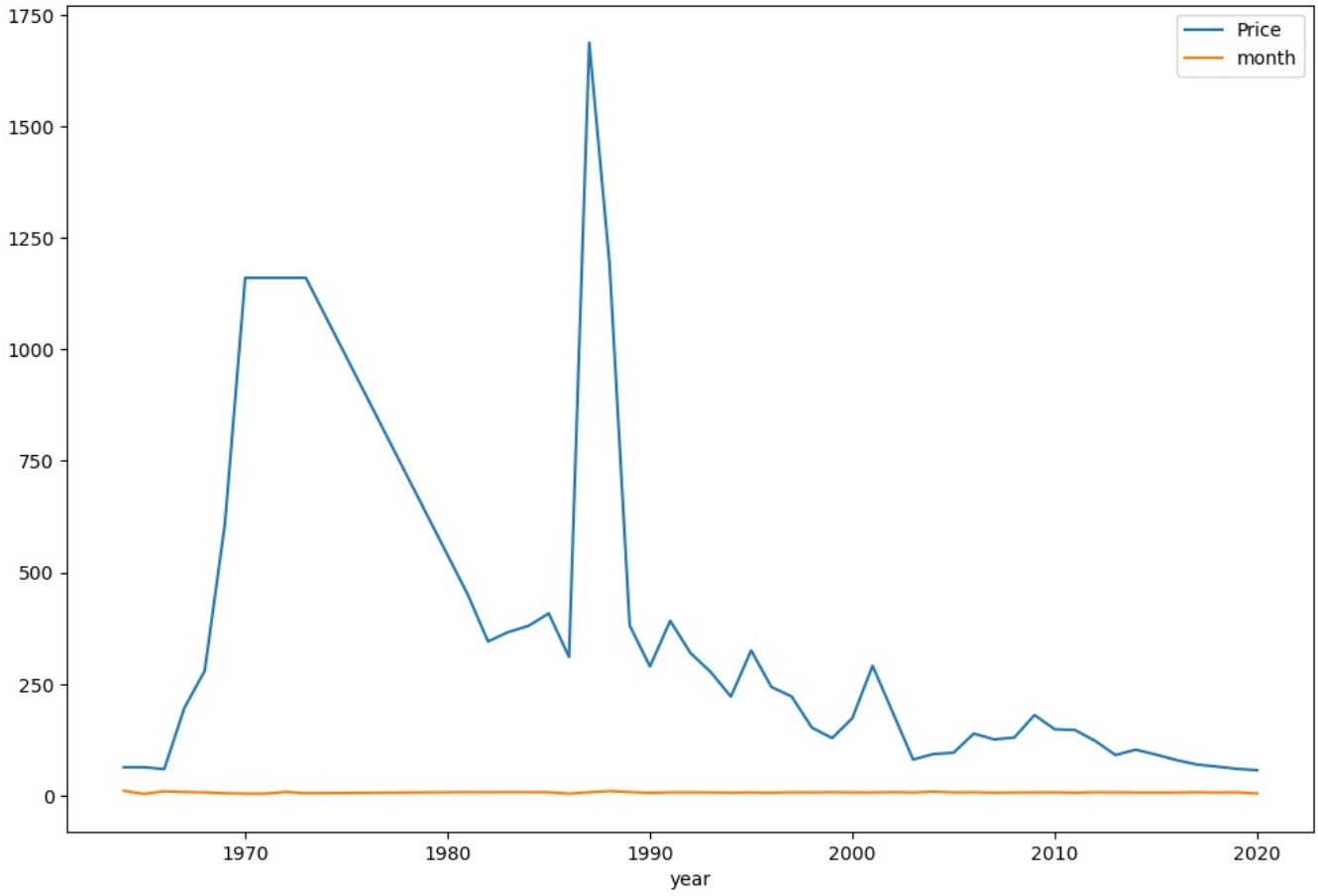
In [50]:
```
avg_price_year = df[df["Price"].notna()]
pd.options.mode.chained_assignment = None
avg_price_year["Price"] = avg_price_year["Price"].str.replace(',', '').astype(float)

avg_price_year.groupby("year").mean().plot(figsize=(12, 8))
```

```
C:\Users\Admin\AppData\Local\Temp\ipykernel_14896\1941227527.py:5: FutureWarning:

The default value of numeric_only in DataFrameGroupBy.mean is deprecated. In a future version, numeric_only wil
l default to False. Either specify numeric_only or select only columns which should be valid for the function.
```

Out[50]:
```
<Axes: xlabel='year'>
```



Space Race between USA and USSR

In [52]:
```
Or_df = df[(df['Country']=='USA') | (df['Country']=='RUS')]
```

In [53]:
```
cold_war_era = Or_df.sort_values("year")

cold_war_era[(cold_war_era.year <= 1991)]
```

Out[53]:

	Organisation	Location	Date	Detail	Rocket_Status	Price	Mission_Status	Country	date	year	month
4323	RVSN USSR	Site 1/5, Baikonur Cosmodrome, Kazakhstan	Fri Oct 04, 1957 19:28 UTC	Sputnik 8K71PS | Sputnik-1	StatusRetired	NaN	Success	RUS	1957-10-04 19:28:00+00:00	1957	10
4322	RVSN USSR	Site 1/5, Baikonur Cosmodrome, Kazakhstan	Sun Nov 03, 1957 02:30 UTC	Sputnik 8K71PS | Sputnik-2	StatusRetired	NaN	Success	RUS	1957-11-03 02:30:00+00:00	1957	11
4321	US Navy	LC-18A, Cape Canaveral AFS, Florida, USA	Fri Dec 06, 1957 16:44 UTC	Vanguard | Vanguard TV3	StatusRetired	NaN	Failure	USA	1957-12-06 16:44:00+00:00	1957	12
4320	AMBA	LC-26A, Cape Canaveral AFS, Florida, USA	Sat Feb 01, 1958 03:48 UTC	Juno I | Explorer 1	StatusRetired	NaN	Success	USA	1958-02-01 03:48:00+00:00	1958	2
4293	US Air Force	LC-11, Cape Canaveral AFS, Florida, USA	Thu Dec 18, 1958 23:02 UTC	SM-65B Atlas | SCORE	StatusRetired	NaN	Success	USA	1958-12-18 23:02:00+00:00	1958	12
...	...	...	...	...	...	...	...	...	...	...	...
1755	NASA	LC-39A, Kennedy Space Center, Florida, USA	Sun Apr 28, 1991 11:33 UTC	Space Shuttle Discovery | STS-39	StatusRetired	450.0	Success	USA	1991-04-28 11:33:00+00:00	1991	4
1754	General Dynamics	SLC-3W, Vandenberg AFB, California, USA	Tue May 14, 1991 15:52 UTC	Atlas-E/F Star-37S-ISS | NOAA-D	StatusRetired	NaN	Success	USA	1991-05-14 15:52:00+00:00	1991	5
1753	RVSN USSR	Site 32/2, Plesetsk Cosmodrome, Russia	Thu May 16, 1991 21:40 UTC	Tsyklon-3 | Cosmos 2143 to 2148	StatusRetired	NaN	Success	RUS	1991-05-16 21:40:00+00:00	1991	5
1762	RVSN USSR	Site 43/3, Plesetsk Cosmodrome, Russia	Fri Mar 22, 1991 12:19 UTC	Molniya-M /Block ML | Molniya-3 n†-148	StatusRetired	NaN	Success	RUS	1991-03-22 12:19:00+00:00	1991	3
1751	RVSN USSR	Site 32/2, Plesetsk Cosmodrome, Russia	Tue Jun 04, 1991 09:00 UTC	Tsyklon-3 | Okean 3	StatusRetired	NaN	Success	RUS	1991-06-04 09:00:00+00:00	1991	6

2432 rows × 11 columns

Comparison of the Total Number of Launches of the USSR and the USA

In [54]:
```
Or_df = df[(df['Country']=='USA') | (df['Country']=='RUS')]
Or_df.head()
```

Out[54]:

	Organisation	Location	Date	Detail	Rocket_Status	Price	Mission_Status	Country	date	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	2020-08-07 05:12:00+00:00	2020	8
2	SpaceX	Pad A, Boca Chica, Texas, USA	Tue Aug 04, 2020 23:57 UTC	Starship Prototype | 150 Meter Hop	StatusActive	NaN	Success	USA	2020-08-04 23:57:00+00:00	2020	8
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	RUS	2020-07-30 21:25:00+00:00	2020	7
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	2020-07-30 11:50:00+00:00	2020	7
6	Roscosmos	Site 31/6, Baikonur Cosmodrome, Kazakhstan	Thu Jul 23, 2020 14:26 UTC	Soyuz 2.1a | Progress MS-15	StatusActive	48.5	Success	RUS	2020-07-23 14:26:00+00:00	2020	7

In [55]:
```
launches_coldwar = Or_df["Country"].value_counts().rename_axis("Country").reset_index(name='counts')
```

```
launches_coldwar.head()
```

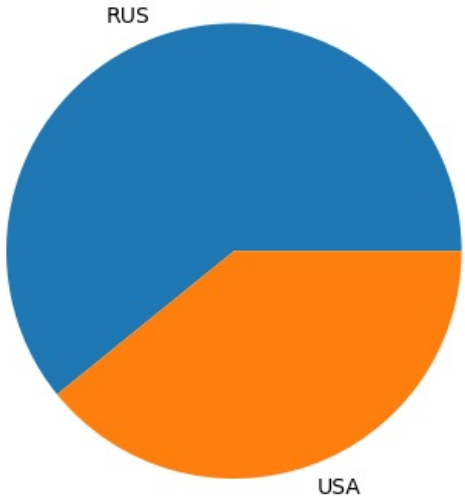
Out[55]:

	Country	counts
0	RUS	2099
1	USA	1351

In [56]:
```
colors = ["#1f77b4", "#ff7f0e"]
grouping = Or_df.groupby("Country").count().reset_index()
sizes = grouping['Mission_Status']
labels = grouping['Country']

plt.pie(sizes, labels = labels, colors = colors)
```

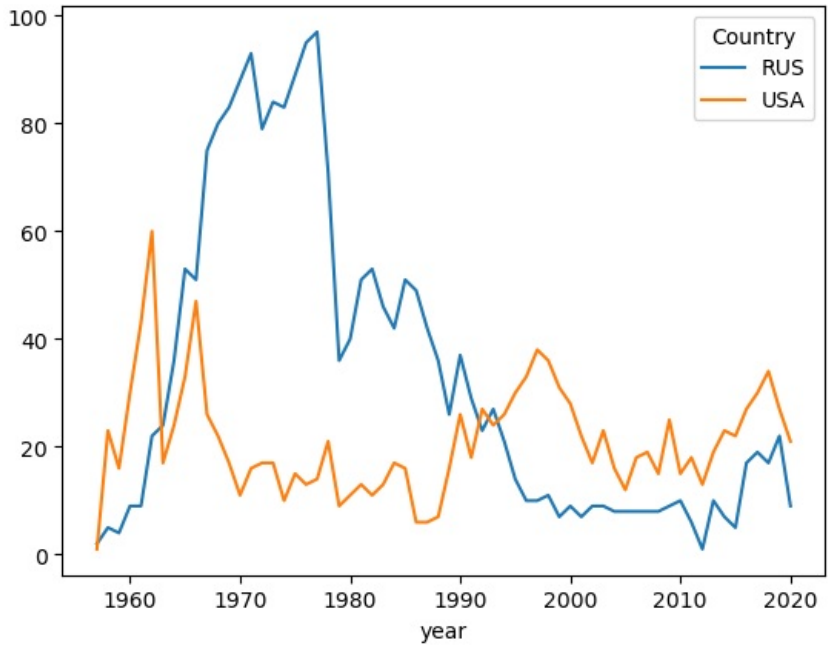
Out[56]:
```
([<matplotlib.patches.Wedge at 0x1fd9749e830>,
  <matplotlib.patches.Wedge at 0x1fd9749e770>],
 [Text(-0.36742349695818666, 1.0368220550716587, 'RUS'),
  Text(0.3674233998838983, -1.0368220894723246, 'USA')])
```



Total Number of Launches of the USSR and the USA Year-On-Year

In [57]:
```
Or_df = df[(df['Country']=='USA') | (df['Country']=='RUS')]
Or_df.groupby(["year", "Country"]).size().unstack().plot()
```

Out[57]:
```
<Axes: xlabel='year'>
```



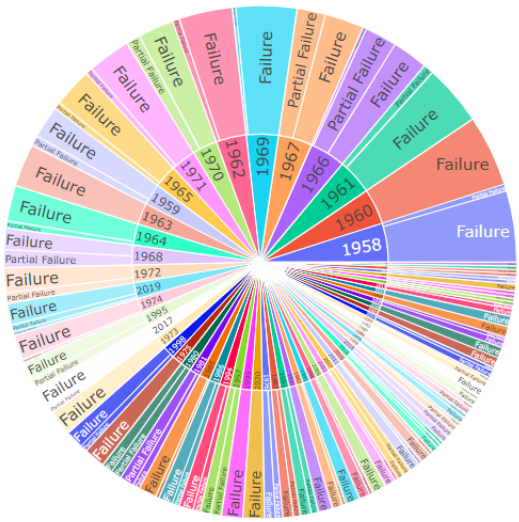
Total Number of Mission Failures Year on Year

In [58]:
```
Or_df = df[df['Mission_Status'].str.contains("Failure")]
Or_df.head()
```

Out[58]:

	Organisation	Location	Date	Detail	Rocket_Status	Price	Mission_Status	Country	date	year	month
11	ExPace	Site 95, Jiuquan Satellite Launch Center, China	Fri Jul 10, 2020 04:17 UTC	Kuaizhou 11 | Jilin-1 02E, CentiSpace-1 S2	StatusActive	28.3	Failure	CHN	2020-07-10 04:17:00+00:00	2020	7
15	Rocket Lab	Rocket Lab LC-1A, M?hia Peninsula, New Zealand	Sat Jul 04, 2020 21:19 UTC	Electron/Curie | Pics Or It Didn?? ¦t Happen	StatusActive	7.5	Failure	NZL	2020-07-04 21:19:00+00:00	2020	7
27	Virgin Orbit	Cosmic Girl, Mojave Air and Space Port, Califo...	Mon May 25, 2020 19:50 UTC	LauncherOne | Demo Flight	StatusActive	12.0	Failure	USA	2020-05-25 19:50:00+00:00	2020	5
36	CASC	LC-2, Xichang Satellite Launch Center, China	Thu Apr 09, 2020 11:46 UTC	Long March 3B/E | Nusantara Dua	StatusActive	29.15	Failure	CHN	2020-04-09 11:46:00+00:00	2020	4
43	CASC	LC-201, Wenchang Satellite Launch Center, China	Mon Mar 16, 2020 13:34 UTC	Long March 7A | XJY-6	StatusActive	NaN	Failure	CHN	2020-03-16 13:34:00+00:00	2020	3

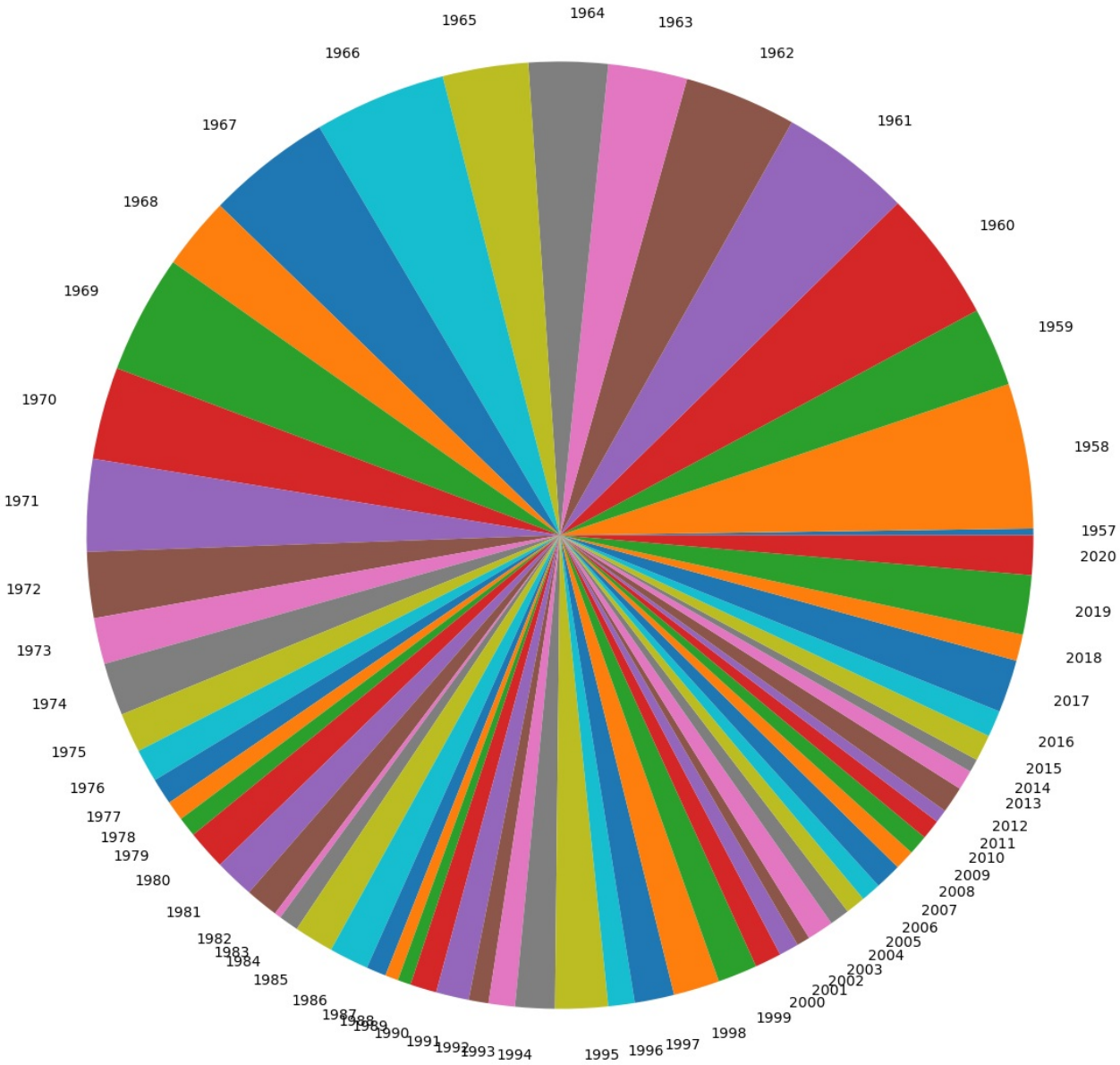
In [59]:
```
yearly_failures = px.data.tips()
fig = px.sunburst(Or_df, path=["year", "Mission_Status"])
fig.show()
```



Percentage of Failures over Time

In [60]:
```
grouping = Or_df.groupby("year").count().reset_index()
sizes = grouping['Mission_Status']
labels = grouping['year']

plt.pie(sizes, labels = labels)
fig = plt.gcf()
fig.set_size_inches(15,15)
plt.show()
```



Which Country was on the Top Considering Total Number of Launches

In [61]:
```
country_launches = df.groupby("year")["Country"].value_counts().rename_axis(["year", "Country"]).reset_index(na

country_launches.loc[country_launches.groupby("year")["counts"].idxmax()]
country_launches.head()
```

Out[61]:

	year	Country	counts
0	1957	RUS	2
1	1957	USA	1
2	1958	USA	23
3	1958	RUS	5
4	1959	USA	16

In [ ]: