Final Project Submission

Please fill out:

- Student name: Charles Ondieki Otwori
- Student pace: Part-time
- Scheduled project review date/time: September 11, 2024
- Instructor name: William Okombo
- Blog post URL:https://github.com/charlesot/Phase-1-project.git
- Tableau visualization URL:https://public.tableau.com/views/Aviation-Project-2024/AviationaccidentsintheUSA?:language=en-US&:sid=&:redirect=auth&:display_count=n&:origin=viz_share_link

Project Overview

The purpose of this project is to use data cleaning, imputation, analysis, and visualization of the aviation accident dataset from 1960 to 2023 by the National Transport Safety Board to generate insights for a business stakeholder. The data set includes aviation accidents and incidents in the United States and international waters. The analysis will identify the safest aircraft models, airports, and risk factors associated with aviation accident risks in the United States. The company will use this analysis to identify the aircraft and airports that carry the lowest risks of aviation accidents for investment purposes.

Business Problem

The company is expanding to a new industry to diversify its portfolio. Commercial and private enterprises are interested in purchasing and operating airplanes. The company has not conducted any aviation business previously. Accidents have a big reputational and financial risk in the aviation business. The analysis will identify the risks, and conduct an aircraft evaluation and comparison to provide data-driven actionable insights.

Data

The data set is publicly available from the National Transportation Safety Board website link: https://www.ntsb.gov/aviationdata/aircraftdata.html. The dataset contains 88,889 rows and 31 columns. It contains event and investigation details, location information, aircraft and flight details, injury and damage information, and report details. The data set selected to draw insights is

Questions to consider :

1. What are the risks related to aviation accidents and incidents in terms of Injury severity, aircraft damage, weather conditions, and flight phases
2. Frequency of accidents across the different makes and models, focusing on injury severity, aircraft damage, and broad phase of flights
3. Which aircraft models and airports have the highest and lowest recorded accidents?
4. What are the common types of damage associated with the aircraft
5. How does the purpose of flight influence the risk profile of the various aircraft

Loading Python packages

```
# pandas for dat amnipulation and analysis
import pandas as pd

# matplotlib and seaborn for visualizations
import matplotlib.pyplot as plt
import seaborn as sns

#Numpy for workng with arrays
import numpy as np
```

Loading data

```
df = pd.read_csv('AviationData.csv', encoding='ISO-8859-1')
```

```
C:\Users\ondie\AppData\Local\Temp\ipykernel_9496\1074977489.py:1: DtypeWarning: Columns (6,7,28) have mixed types. Specify dtype option on import or set low_memory=False.
  df = pd.read_csv('AviationData.csv', encoding='ISO-8859-1')
```

```
# create  Copy of dataset
df2=df.copy(deep = True)
```

```
## Data Understanding
```

```
# Check the number of rows and columns: (88889, 31)
df.shape
```

```
(88889, 31)
```

```
#Checking the first 5 rows
df.head()
```

	Event.Id	Investigation.Type	Accident.Number	Event.Date	Location	Country	Latitude	Longitude	Airport.Code	Airport.Name	...	Purpose.of.flight	Air.carrier	Total.
0	20001218X45444	Accident	SEA87LA080	1948-10-24	MOOSE CREEK, ID	United States	NaN	NaN	NaN	NaN	...	Personal	NaN	
1	20001218X45447	Accident	LAX94LA336	1962-07-19	BRIDGEPORT, CA	United States	NaN	NaN	NaN	NaN	...	Personal	NaN	
2	20061025X01555	Accident	NYC07LA005	1974-08-30	Saltville, VA	United States	36.922223	-81.878056	NaN	NaN	...	Personal	NaN	
3	20001218X45448	Accident	LAX96LA321	1977-06-19	EUREKA, CA	United States	NaN	NaN	NaN	NaN	...	Personal	NaN	
4	20041105X01764	Accident	CHI79FA064	1979-08-02	Canton, OH	United States	NaN	NaN	NaN	NaN	...	Personal	NaN	

5 rows × 31 columns

```
# Checking the last 5
df.tail()
```

	Event.Id	Investigation.Type	Accident.Number	Event.Date	Location	Country	Latitude	Longitude	Airport.Code	Airport.Name	...	Purpose.of.flight	Air.carrier	Total.F
88884	20221227106491	Accident	ERA23LA093	2022-12-26	Annapolis, MD	United States	NaN	NaN	NaN	NaN	...	Personal	NaN	
88885	20221227106494	Accident	ERA23LA095	2022-12-26	Hampton, NH	United States	NaN	NaN	NaN	NaN	...	NaN	NaN	
88886	20221227106497	Accident	WPR23LA075	2022-12-26	Payson, AZ	United States	341525N	1112021W	PAN	PAYSON	...	Personal	NaN	
88887	20221227106498	Accident	WPR23LA076	2022-12-26	Morgan, UT	United States	NaN	NaN	NaN	NaN	...	Personal	MC CESSNA 210N LLC	
88888	20221230106513	Accident	ERA23LA097	2022-12-29	Athens, GA	United States	NaN	NaN	NaN	NaN	...	Personal	NaN	

5 rows × 31 columns

```
#checking 5 random rows
df.sample(5)
```

	Event.Id	Investigation.Type	Accident.Number	Event.Date	Location	Country	Latitude	Longitude	Airport.Code	Airport.Name	...	Purpose.of.flight	Air.carrier
19869	20001213X25328	Incident	NYC88IA109A	1988-03-18	MORRISTOWN, NJ	United States	NaN	NaN	NaN	NaN	...	Unknown	Continental Airlines
25570	20001212X23051	Accident	ANC90LA076	1990-05-24	UGANIK BAY, AK	United States	NaN	NaN	NaN	NaN	...	Unknown	Markair Express
67367	20091023X90419	Accident	CEN10FA027	2009-10-23	Adrian, MI	United States	415610N	0835958W	KADG	Lenawee County Airport	...	Personal	DEM Enterprises, LLC
87823	20220610105238	Accident	GAA22WA200	2022-05-20	MACIZO DEL AUYÁN-TEPUI, OF	Venezuela	055130N	0622626W	NaN	NaN	...	NaN	NaN
69434	20110222X52835	Accident	WPR11CA141	2011-01-18	Aurora, OR	United States	045159N	0122469W	UAO	Aurora State	...	Personal	Phillip C. Spencer

5 rows × 31 columns

```
# checking the available
df.columns
```

```
Index(['Event.Id', 'Investigation.Type', 'Accident.Number', 'Event.Date',
       'Location', 'Country', 'Latitude', 'Longitude', 'Airport.Code',
       'Airport.Name', 'Injury.Severity', 'Aircraft.damage',
       'Aircraft.Category', 'Registration.Number', 'Make', 'Model',
       'Amateur.Built', 'Number.of.Engines', 'Engine.Type', 'FAR.Description',
       'Schedule', 'Purpose.of.flight', 'Air.carrier', 'Total.Fatal.Injuries',
       'Total.Serious.Injuries', 'Total.Minor.Injuries', 'Total.Uninjured',
       'Weather.Condition', 'Broad.phase.of.flight', 'Report.Status',
       'Publication.Date'],
      dtype='object')
```

```
# Cheking the details of the data set
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 88889 entries, 0 to 88888
Data columns (total 31 columns):
 #   Column                  Non-Null Count  Dtype  
---  ------                  --------------  -----  
 0   Event.Id                88889 non-null  object 
 1   Investigation.Type      88889 non-null  object 
 2   Accident.Number         88889 non-null  object 
 3   Event.Date              88889 non-null  object 
 4   Location                88837 non-null  object 
 5   Country                 88663 non-null  object 
 6   Latitude                34382 non-null  object 
 7   Longitude               34373 non-null  object 
 8   Airport.Code            50132 non-null  object 
 9   Airport.Name            52704 non-null  object 
 10  Injury.Severity         87889 non-null  object 
 11  Aircraft.damage         85695 non-null  object 
 12  Aircraft.Category       32287 non-null  object 
 13  Registration.Number     87507 non-null  object 
 14  Make                    88826 non-null  object 
 15  Model                   88797 non-null  object 
 16  Amateur.Built           88787 non-null  object 
 17  Number.of.Engines       82805 non-null  float64
 18  Engine.Type             81793 non-null  object 
 19  FAR.Description         32023 non-null  object 
 20  Schedule                12582 non-null  object 
 21  Purpose.of.flight       82697 non-null  object 
 22  Air.carrier             16648 non-null  object 
 23  Total.Fatal.Injuries    77488 non-null  float64
 24  Total.Serious.Injuries  76379 non-null  float64
 25  Total.Minor.Injuries    76956 non-null  float64
 26  Total.Uninjured         82977 non-null  float64
 27  Weather.Condition       84397 non-null  object 
 28  Broad.phase.of.flight   61724 non-null  object 
 29  Report.Status           82505 non-null  object 
 30  Publication.Date        75118 non-null  object 
dtypes: float64(5), object(26)
memory usage: 21.0+ MB
```

```
#Checking the summary statistics for numerical columns
df.describe()
```

	Number.of.Engines	Total.Fatal.Injuries	Total.Serious.Injuries	Total.Minor.Injuries	Total.Uninjured
count	82805.000000	77488.000000	76379.000000	76956.000000	82977.000000
mean	1.146585	0.647855	0.279881	0.357061	5.325440
std	0.446510	5.485960	1.544084	2.235625	27.913634
min	0.000000	0.000000	0.000000	0.000000	0.000000
25%	1.000000	0.000000	0.000000	0.000000	0.000000
50%	1.000000	0.000000	0.000000	0.000000	1.000000
75%	1.000000	0.000000	0.000000	0.000000	2.000000
max	8.000000	349.000000	161.000000	380.000000	699.000000

```
#summary statistics for categorical
df.describe(include=['object'])
```

	Event.Id	Investigation.Type	Accident.Number	Event.Date	Location	Country	Latitude	Longitude	Airport.Code	Airport.Name	...	Amateur.Built	Engine.Type	FAR.D
count	88889	88889	88889	88889	88837	88663	34382	34373	50132	52704	...	88787	81793	
unique	87951	2	88863	14782	27758	219	25592	27156	10374	24870	...	2	12	
top	20001212X19172	Accident	CEN22LA149	1984-06-30	ANCHORAGE, AK	United States	332739N	0112457W	NONE	Private	...	No	Reciprocating	
freq	3	85015	2	25	434	82248	19	24	1488	240	...	80312	69530	

4 rows × 26 columns

Data Cleaning

```
# Getting to know more about the dataset by accessing its information
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 88889 entries, 0 to 88888
Data columns (total 31 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   Event.Id                88889 non-null  object
 1   Investigation.Type      88889 non-null  object
 2   Accident.Number         88889 non-null  object
 3   Event.Date              88889 non-null  object
 4   Location                88837 non-null  object
 5   Country                 88663 non-null  object
 6   Latitude                34382 non-null  object
 7   Longitude               34373 non-null  object
 8   Airport.Code            50132 non-null  object
 9   Airport.Name            52704 non-null  object
 10  Injury.Severity         87889 non-null  object
 11  Aircraft.damage         85695 non-null  object
 12  Aircraft.Category       32287 non-null  object
 13  Registration.Number     87507 non-null  object
 14  Make                    88826 non-null  object
 15  Model                   88797 non-null  object
 16  Amateur.Built           88787 non-null  object
 17  Number.of.Engines       82805 non-null  float64
 18  Engine.Type             81793 non-null  object
 19  FAR.Description         32023 non-null  object
 20  Schedule                12582 non-null  object
 21  Purpose.of.flight       82697 non-null  object
 22  Air.carrier             16648 non-null  object
 23  Total.Fatal.Injuries    77488 non-null  float64
 24  Total.Serious.Injuries  76379 non-null  float64
 25  Total.Minor.Injuries    76956 non-null  float64
 26  Total.Uninjured         82977 non-null  float64
 27  Weather.Condition       84397 non-null  object
 28  Broad.phase.of.flight   61724 non-null  object
 29  Report.Status           82505 non-null  object
 30  Publication.Date        75118 non-null  object
dtypes: float64(5), object(26)
```

```
memory usage: 21.0+ MB
```

```
# checking the missing values in each column
df.isna().sum()
```

```
Event.Id                    0
Investigation.Type          0
Accident.Number             0
Event.Date                  0
Location                   52
Country                   226
Latitude                54507
Longitude               54516
Airport.Code            38757
Airport.Name            36185
Injury.Severity          1000
Aircraft.damage          3194
Aircraft.Category       56602
Registration.Number      1382
Make                       63
Model                      92
Amateur.Built             102
Number.of.Engines        6084
Engine.Type              7096
FAR.Description         56866
Schedule                76307
Purpose.of.flight        6192
Air.carrier             72241
Total.Fatal.Injuries    11401
Total.Serious.Injuries  12510
Total.Minor.Injuries    11933
Total.Uninjured          5912
Weather.Condition        4492
Broad.phase.of.flight   27165
Report.Status            6384
Publication.Date        13771
dtype: int64
```

```
# Preview data
df.head()
```

	Event.Id	Investigation.Type	Accident.Number	Event.Date	Location	Country	Latitude	Longitude	Airport.Code	Airport.Name	...	Purpose.of.flight	Air.carrier	Total.
0	20001218X45444	Accident	SEA87LA080	1948-10-24	MOOSE CREEK, ID	United States	NaN	NaN	NaN	NaN	...	Personal	NaN	
1	20001218X45447	Accident	LAX94LA336	1962-07-19	BRIDGEPORT, CA	United States	NaN	NaN	NaN	NaN	...	Personal	NaN	
2	20061025X01555	Accident	NYC07LA005	1974-08-30	Saltville, VA	United States	36.922223	-81.878056	NaN	NaN	...	Personal	NaN	
3	20001218X45448	Accident	LAX96LA321	1977-06-19	EUREKA, CA	United States	NaN	NaN	NaN	NaN	...	Personal	NaN	
4	20041105X01764	Accident	CHI79FA064	1979-08-02	Canton, OH	United States	NaN	NaN	NaN	NaN	...	Personal	NaN	

5 rows × 31 columns

Converting data types

```
df.dtypes
```

```
Event.Id                  object
Investigation.Type        object
Accident.Number           object
Event.Date                object
Location                  object
Country                   object
Latitude                  object
Longitude                 object
Airport.Code              object
Airport.Name              object
Injury.Severity           object
Aircraft.damage           object
Aircraft.Category         object
Registration.Number       object
Make                      object
Model                     object
Amateur.Built             object
Number.of.Engines        float64
Engine.Type               object
FAR.Description           object
Schedule                  object
Purpose.of.flight         object
Air.carrier               object
Total.Fatal.Injuries     float64
Total.Serious.Injuries   float64
Total.Minor.Injuries     float64
Total.Uninjured          float64
Weather.Condition         object
Broad.phase.of.flight     object
Report.Status             object
Publication.Date          object
dtype: object
```

```
df['Number.of.Engines']= df['Number.of.Engines'].astype('float')
```

```
df['Total.Fatal.Injuries'] = df['Total.Fatal.Injuries'].astype('float')
```

```
#checking the data types
df.dtypes
```

```
Event.Id                  object
Investigation.Type        object
Accident.Number           object
Event.Date                object
Location                  object
Country                   object
Latitude                  object
Longitude                 object
Airport.Code              object
Airport.Name              object
Injury.Severity           object
Aircraft.damage           object
Aircraft.Category         object
Registration.Number       object
Make                      object
```

```
Model                    object
Amateur.Built            object
Number.of.Engines       float64
Engine.Type              object
FAR.Description          object
Schedule                 object
Purpose.of.flight        object
Air.carrier              object
Total.Fatal.Injuries    float64
Total.Serious.Injuries  float64
Total.Minor.Injuries    float64
Total.Uninjured         float64
Weather.Condition        object
Broad.phase.of.flight    object
Report.Status            object
Publication.Date         object
dtype: object
```

Dropping columns

```
#Dropping columns with more than 50% missing values and not important in analysis
df.drop(['Latitude', 'Longitude','FAR.Description'],inplace= True, axis=1)


# Dropping additional columns not important for analysis purposes
df.drop(['Accident.Number','Airport.Code','Registration.Number', 'Publication.Date','Report.Status'],inplace= True, axis=1)
```

Missing categorical data

```
# Replacing missing values with Unknown
df['Location'].fillna('Unknown', inplace=True)
df['Country'].fillna('Unknown', inplace=True)
df['Airport.Name'].fillna('Unknown', inplace=True)
df['Injury.Severity'].fillna('Unknown', inplace=True)
df['Aircraft.damage'].fillna('Unknown', inplace=True)
df['Aircraft.Category'].fillna('Unknown', inplace=True)
df['Amateur.Built'].fillna('Unknown', inplace=True)
df['Purpose.of.flight'].fillna('Unknown', inplace=True)
df['Weather.Condition'].fillna('Unknown', inplace=True)
df['Air.carrier'].fillna('Unknown', inplace=True)
df['Make'].fillna('Unknown', inplace=True)
df['Model'].fillna('Unknown', inplace=True)
df['Engine.Type'].fillna('Unknown', inplace=True)
df['Broad.phase.of.flight'].fillna('Unknown', inplace=True)
df['Schedule'].fillna('Unknown', inplace=True)
```

Missing numerical data

```
df['Number.of.Engines'].mean()
```

```
1.1465853511261397
```

```
df['Number.of.Engines'].mode()
```

```
0    1.0
Name: Number.of.Engines, dtype: float64
```

```
df['Total.Uninjured'].mean()
```

```
5.325439579642552
```

```
df['Total.Uninjured'].mode()
```

```
0    0.0
Name: Total.Uninjured, dtype: float64
```

```
#Replacing the missing values with mode.There is left skew distribution and outliers

df['Number.of.Engines'].fillna(df['Number.of.Engines'].mode()[0], inplace=True)
df['Total.Serious.Injuries'].fillna(df['Total.Serious.Injuries'].mode()[0], inplace=True)
df['Total.Fatal.Injuries'].fillna(df['Total.Fatal.Injuries'].mode()[0], inplace=True)
df['Total.Minor.Injuries'].fillna(df['Total.Minor.Injuries'].mode()[0], inplace=True)
df['Total.Uninjured'].fillna(df['Total.Uninjured'].mode()[0], inplace=True)
```

```
#checking missing values
df.isna().sum()
```

```
Event.Id                 0
Investigation.Type       0
Event.Date               0
Location                 0
Country                  0
Airport.Name             0
Injury.Severity          0
Aircraft.damage          0
Aircraft.Category        0
Make                     0
Model                    0
Amateur.Built            0
Number.of.Engines        0
Engine.Type              0
Schedule                 0
Purpose.of.flight        0
Air.carrier              0
Total.Fatal.Injuries     0
Total.Serious.Injuries   0
Total.Minor.Injuries     0
Total.Uninjured          0
Weather.Condition        0
Broad.phase.of.flight    0
dtype: int64
```

Handling Inconsistent data

```
#Stripping the leading and trailing spaces
df.columns = df.columns.str.strip()
```

```
#Checking the unique values in the Make column
df['Make'].value_counts()
```

```
Make
Cessna             22227
Piper              12029
CESSNA              4922
Beech               4330
PIPER               2841
                   ...
Leonard Walters        1
Maule Air Inc.         1
Motley Vans            1
Perlick                1
ROYSE RALPH L          1
Name: count, Length: 8237, dtype: int64
```

```
df['Make']= df['Make'].str.upper()
```

```
df['Make'].value_counts()
```

```
Make
CESSNA           27149
PIPER            14870
BEECH             5372
BOEING            2745
BELL              2722
                 ...
COHEN                1
KITCHENS             1
LUTES                1
IZATT                1
ROYSE RALPH L        1
Name: count, Length: 7587, dtype: int64
```

```
df['Make'] = df['Make'].replace(to_replace=r'\b(?:CES\S*|CESNA AIRCRAFT)\b', value='CESSNA', regex=True)
```

```
df['Make'].value_counts()
```

```
Make
CESSNA                  27151
PIPER                   14870
BEECH                    5372
BOEING                   2745
BELL                     2722
                        ...
BOYKIN B J                  1
BENSEN AIRCRAFT CORP.       1
STEEN AERO LAB              1
CAP                         1
ROYSE RALPH L               1
Name: count, Length: 7585, dtype: int64
```

```
df['Model'].value_counts()
```

```
Model
152             2367
172             1756
```

```
172N             1164
PA-28-140         932
150               829
                  ...
GC-1-A              1
737-3S3             1
MBB-BK117-B2        1
GLASSAIR GL25       1
M-8 EAGLE           1
Name: count, Length: 12318, dtype: int64
```

```
df.columns
```

```
Index(['Event.Id', 'Investigation.Type', 'Event.Date', 'Location', 'Country',
       'Airport.Name', 'Injury.Severity', 'Aircraft.damage',
       'Aircraft.Category', 'Make', 'Model', 'Amateur.Built',
       'Number.of.Engines', 'Engine.Type', 'Schedule', 'Purpose.of.flight',
       'Air.carrier', 'Total.Fatal.Injuries', 'Total.Serious.Injuries',
       'Total.Minor.Injuries', 'Total.Uninjured', 'Weather.Condition',
       'Broad.phase.of.flight'],
      dtype='object')
```

Handling duplicates

```
#check duplicates in the data
df.duplicated().sum()
```

```
24
```

```
# removing duplicates
df.drop_duplicates(inplace=True)
```

```
df.duplicated().sum()
```

```
0
```

Cleaning Location information

```
# splitting the Location to extrext the state code
df['State_Code']=df['Location'].str.split(',').str[-1].str.strip()
```

```
#Filling the missing state codes with unknown
df['State_Code'].fillna('Unknown', inplace=True)
```

```
df['State_Code'].value_counts()
```

```
State_Code
CA                  8854
TX                  5912
FL                  5821
AK                  5672
AZ                  2831
                    ...
ROTA ISLAND            1
```

```
St Lucia               1
CHUUK ISLAND           1
CAMERON 278B           1
Wallis and Futuna      1
Name: count, Length: 529, dtype: int64
```

Formatting the date

```
#Converting Event.date into the date format
df['Event.Date'] = pd.to_datetime(df['Event.Date'])
df['Year'] = df['Event.Date'].dt.year
df['Month'] = df['Event.Date'].dt.month_name()
df['Day'] = df['Event.Date'].dt.day_name()
print(df[['Event.Date', 'Year', 'Month', 'Day']].head())
```

```
  Event.Date  Year    Month       Day
0 1948-10-24  1948  October    Sunday
1 1962-07-19  1962     July  Thursday
2 1974-08-30  1974   August    Friday
3 1977-06-19  1977     June    Sunday
4 1979-08-02  1979   August  Thursday
```

```
df['Injury.Severity'].value_counts()
```

```
Injury.Severity
Non-Fatal     67345
Fatal(1)       6166
Fatal          5262
Fatal(2)       3706
Incident       2217
               ...
Fatal(80)         1
Fatal(217)        1
Fatal(169)        1
Fatal(88)         1
Fatal(189)        1
Name: count, Length: 110, dtype: int64
```

Removing nonnumeric entries in numeric column

```
#Removing nonnumeric entries in Injury.Severity column
df['Injury.Severity'] = df['Injury.Severity'].astype(str).str.extract('(\d+)').astype(str)
```

```
df['Injury.Severity'].value_counts()
```

```
Injury.Severity
nan    76309
1       6166
2       3706
3       1147
4        810
       ...
88         1
156        1
60         1
30         1
```

```
57         1
Name: count, Length: 104, dtype: int64
```

```
df['Total.Fatal.Injuries'].value_counts()
```

```
Total.Fatal.Injuries
0.0      71060
1.0       8882
2.0       5168
3.0       1589
4.0       1101
         ...
156.0        1
68.0         1
31.0         1
115.0        1
176.0        1
Name: count, Length: 125, dtype: int64
```

```
#Removing nonnumeric entries in numeric column
df['Total.Fatal.Injuries'] = pd.to_numeric(df['Total.Fatal.Injuries'], errors='coerce')
```

```
df['Total.Fatal.Injuries'].value_counts()
```

```
Total.Fatal.Injuries
0.0      71060
1.0       8882
2.0       5168
3.0       1589
4.0       1101
         ...
156.0        1
68.0         1
31.0         1
115.0        1
176.0        1
Name: count, Length: 125, dtype: int64
```

```
# Confirming missing values are handled
df.isna().sum()
```

```
Event.Id                 0
Investigation.Type       0
Event.Date               0
Location                 0
Country                  0
Airport.Name             0
Injury.Severity          0
Aircraft.damage          0
Aircraft.Category        0
Make                     0
Model                    0
Amateur.Built            0
Number.of.Engines        0
Engine.Type              0
Schedule                 0
Purpose.of.flight        0
Air.carrier              0
Total.Fatal.Injuries     0
```

```
Total.Serious.Injuries    0
Total.Minor.Injuries      0
Total.Uninjured           0
Weather.Condition         0
Broad.phase.of.flight     0
State_Code                0
Year                      0
Month                     0
Day                       0
dtype: int64
```

```
# Replace all variations of 'Private Airstrip' with a consistent name 'Private Airstrip'
df['Airport.Name'] = df['Airport.Name'].replace(['Private', 'Private Airstrip', 'PVT', 'Private strip', 'PRIVATE', 'PRIVATE STRIP','Private Airstrip Airstrip','Private Airstrip Strip','Pr
```

```
df.head()
```

	Event.Id	Investigation.Type	Event.Date	Location	Country	Airport.Name	Injury.Severity	Aircraft.damage	Aircraft.Category	Make	...	Total.Fatal.Injuries	Tot
0	20001218X45444	Accident	1948-10-24	MOOSE CREEK, ID	United States	Unknown	2	Destroyed	Unknown	STINSON	...	2.0	
1	20001218X45447	Accident	1962-07-19	BRIDGEPORT, CA	United States	Unknown	4	Destroyed	Unknown	PIPER	...	4.0	
2	20061025X01555	Accident	1974-08-30	Saltville, VA	United States	Unknown	3	Destroyed	Unknown	CESSNA	...	3.0	
3	20001218X45448	Accident	1977-06-19	EUREKA, CA	United States	Unknown	2	Destroyed	Unknown	ROCKWELL	...	2.0	
4	20041105X01764	Accident	1979-08-02	Canton, OH	United States	Unknown	1	Destroyed	Unknown	CESSNA	...	1.0	

5 rows × 27 columns

Exploratory data analysis

Checking the summary statistics for numerical columns

```
df.describe()
```

	Event.Date	Number.of.Engines	Total.Fatal.Injuries	Total.Serious.Injuries	Total.Minor.Injuries	Total.Uninjured	Year
count	88865	88865.000000	88865.000000	88865.000000	88865.000000	88865.000000	88865.000000
mean	1999-09-18 00:48:20.255443840	1.136533	0.564699	0.240522	0.309177	4.968188	1999.207506
min	1948-10-24 00:00:00	0.000000	0.000000	0.000000	0.000000	0.000000	1948.000000
25%	1989-01-15 00:00:00	1.000000	0.000000	0.000000	0.000000	0.000000	1989.000000
50%	1998-07-18 00:00:00	1.000000	0.000000	0.000000	0.000000	1.000000	1998.000000
75%	2009-07-02 00:00:00	1.000000	0.000000	0.000000	0.000000	2.000000	2009.000000
max	2022-12-29 00:00:00	8.000000	349.000000	161.000000	380.000000	699.000000	2022.000000
std	NaN	0.432550	5.127298	1.434789	2.083987	26.992800	11.888407

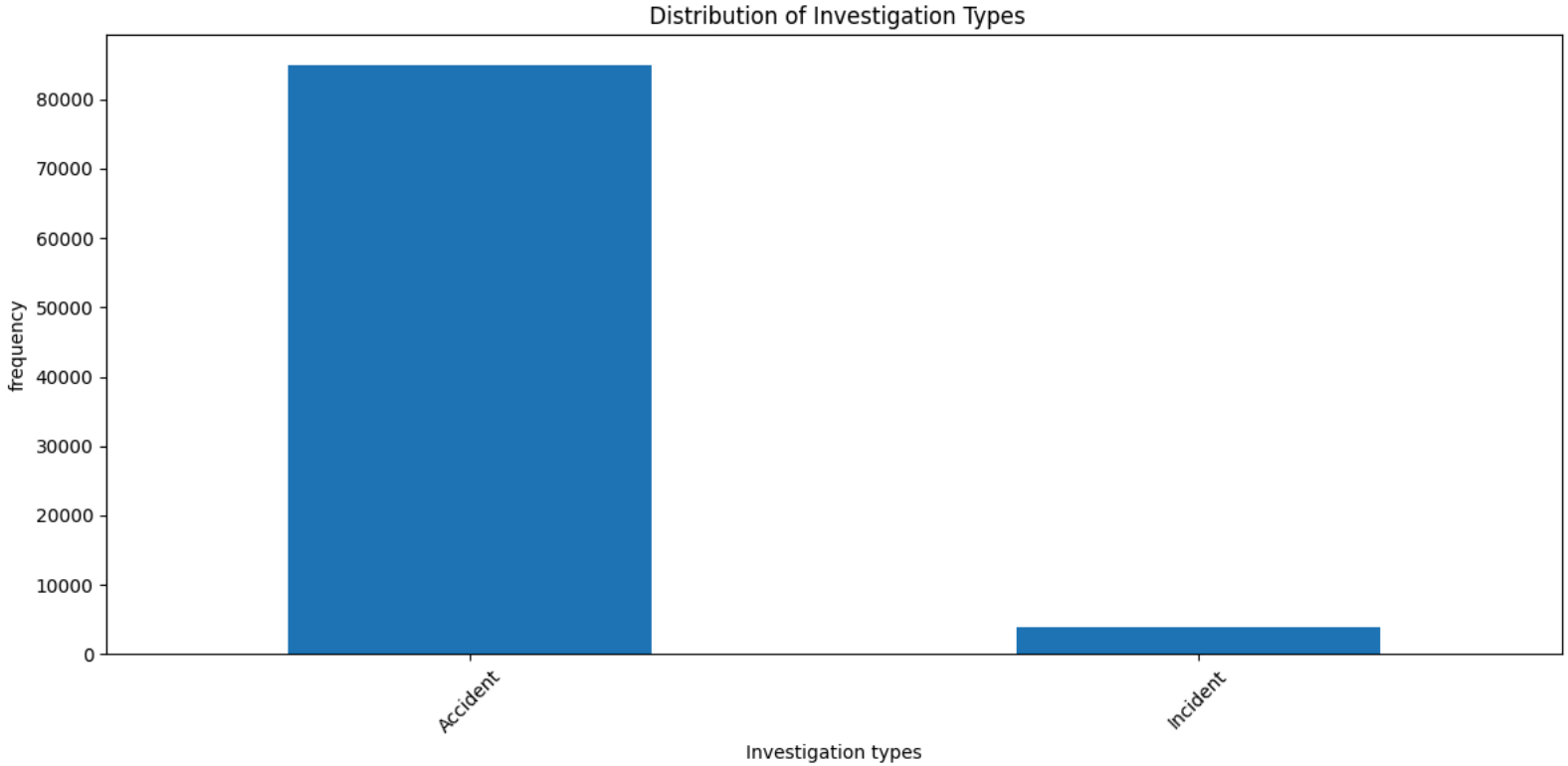
Summary statistics for categorical columns

```
df.describe(include=['object'])
```

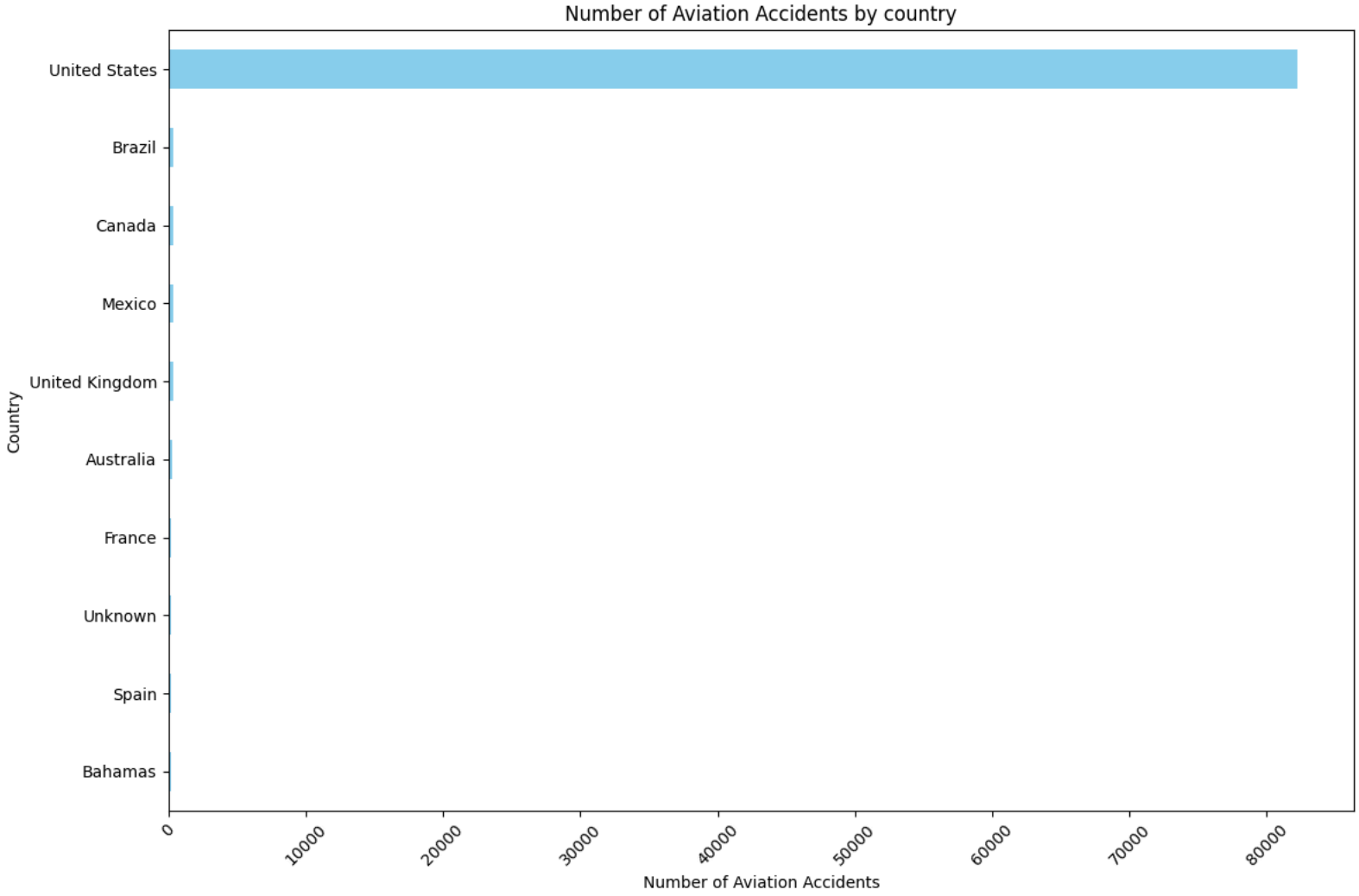
	Event.Id	Investigation.Type	Location	Country	Airport.Name	Injury.Severity	Aircraft.damage	Aircraft.Category	Make	Model	Amateur.Built	Engine.Type	Schec
count	88865	88865	88865	88865	88865	88865	88865	88865	88865	88865	88865	88865	88
unique	87951	2	27758	219	24857	104	4	15	7585	12318	3	12	
top	20001212X19172	Accident	ANCHORAGE, AK	United States	Unknown	nan	Substantial	Unknown	CESSNA	152	No	Reciprocating	Unkn
freq	3	84994	434	82226	36180	76309	64134	56597	27146	2365	80289	69515	76

Univariate Analysis for categorical variables

```
# Distribution of Investigation types
fig, axes = plt.subplots(figsize=(12, 6))

#Plotting bar plot for Distribution of investigation type
df['Investigation.Type'].value_counts().plot(kind = 'bar',ax=axes, grid=False)

# Clean up the labels
axes.set_xticklabels([label.strip("(),'") for label in df['Investigation.Type'].value_counts().index])

axes.set_title(' Distribution of Investigation Types')
axes.set_xlabel('Investigation types')
axes.set_ylabel('frequency')
axes.tick_params(axis='x', rotation=45)

# Adjust layout for better spacing
plt.tight_layout()

# Show the plots
plt.show()
```




```
# Plotting the number of aviation accident per country
fig, axes = plt.subplots(figsize=(12, 8))

#plot  Aviation Accidents by year
Accident_countries=df['Country'].value_counts().head(10)
Accident_countries.plot(kind='barh', ax=axes, color='skyblue')
axes.set_title('Number of Aviation Accidents by country')
axes.set_xlabel('Number of Aviation Accidents')
axes.set_ylabel('Country')
axes.tick_params(axis='x', rotation=45)

# Inverting the Y-axis to show the most frequent country on top
axes.invert_yaxis()

# Adjust layout for better spacing
plt.tight_layout()

# Show the plots
plt.show()
```



Further analysis will focus on only accidents occuring in the United States of America . It will also focus on only aircrafts.The rationale of choice of only USA is because the majority of the reports are in USA . This will also form part of market analysis for starting the new venture in USA and expanding to the rest of the world . The company is interested operating aircrafts. Incidents will also be filtered out. The analysis will also focus on Airplanes and helicopters only.

```
# Filter to include only records from the USA and aircrafts
usa_aircraft_df = df[(df['Country'] == 'United States') & (df['Make'].notnull())]

# Filter to include only accidents (excluding incidents)
usa_accidents_df = usa_aircraft_df[usa_aircraft_df['Investigation.Type'] == 'Accident']

#Filter to include only helicopters and airplanes
```

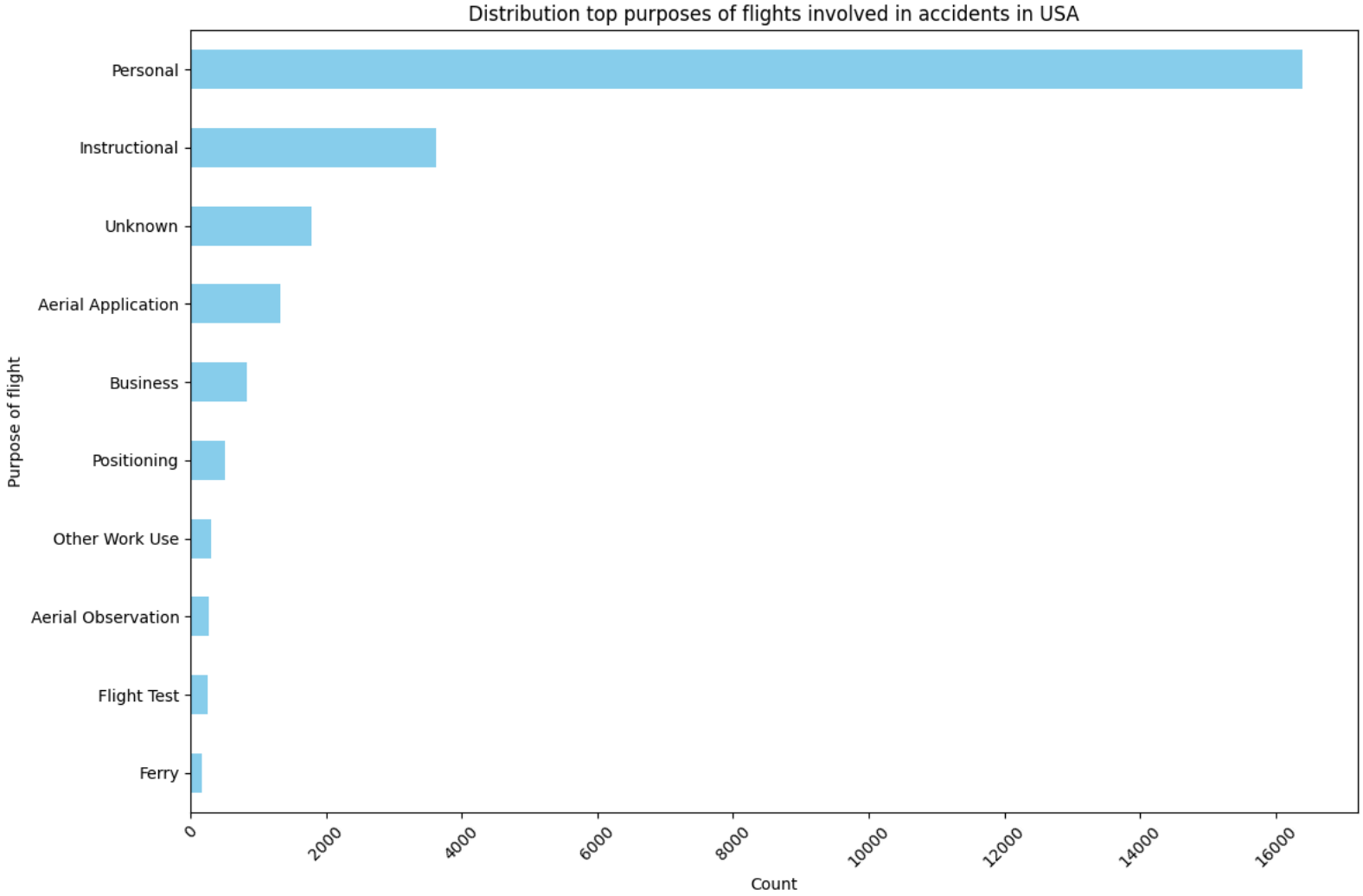
```
usa_accidents_df = usa_accidents_df[usa_accidents_df['Aircraft.Category'].isin(['Helicopter', 'Airplane'])]
```

```
usa_accidents_df.shape
```

```
(26324, 27)
```

```
# Save the DataFrame to a CSV file
usa_accidents_df.to_csv('usa_accidents.csv', index=False)
```

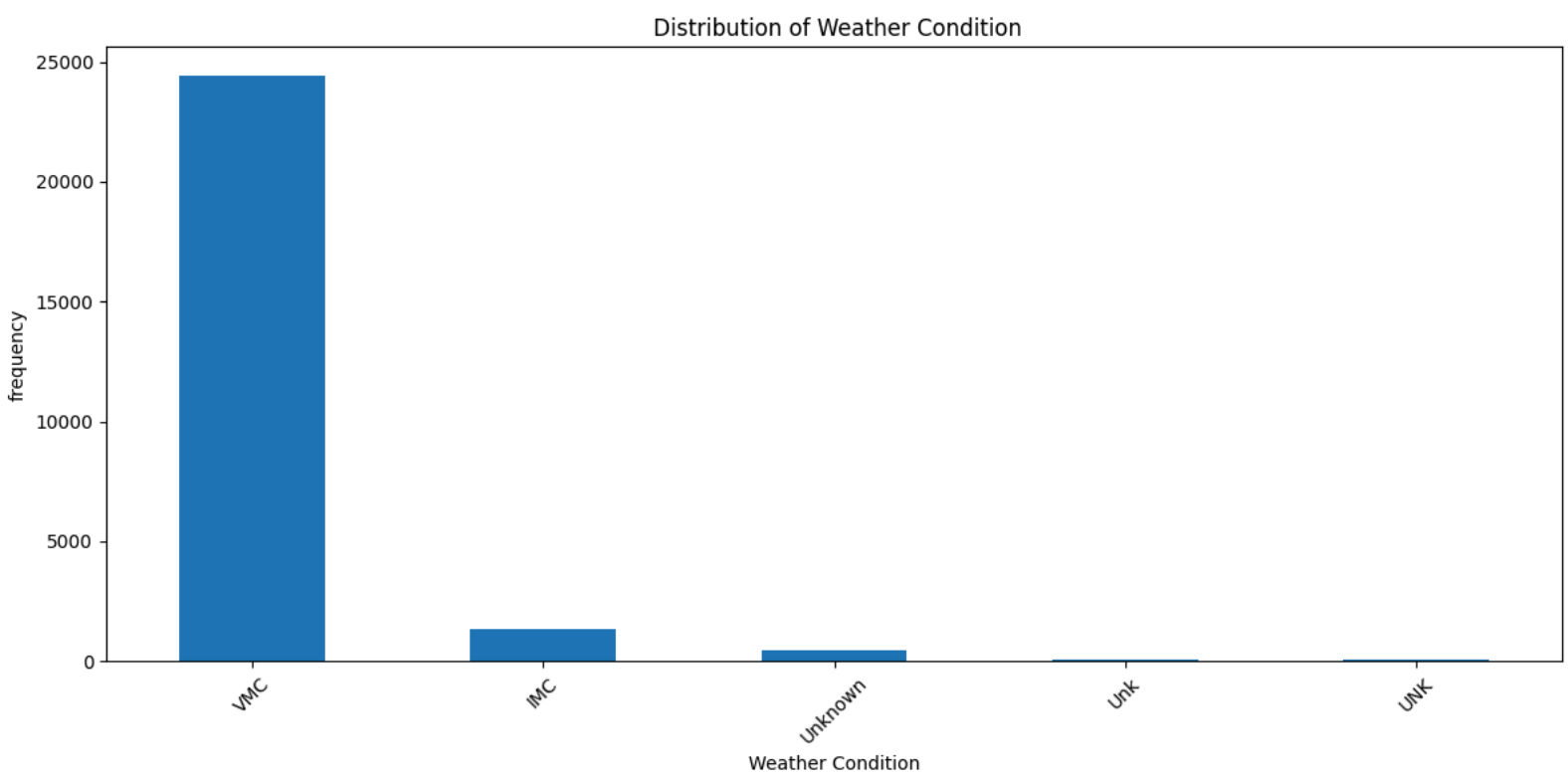
```
# Plotting the distribution top 10 purposes of flights involved in accidents in the USA
fig, axes = plt.subplots(figsize=(12, 8))

#plot of schedule
Accident_purpose=usa_accidents_df['Purpose.of.flight'].value_counts().head(10)

Accident_purpose.plot(kind='barh', ax=axes, color='skyblue')
axes.set_title('Distribution top purposes of flights involved in accidents in USA')
axes.set_xlabel('Count')
axes.set_ylabel('Purpose of flight')
axes.tick_params(axis='x', rotation=45)

# Inverting the Y-axis to show the most frequent purpose at the top
axes.invert_yaxis()


# Adjust layout for better spacing
plt.tight_layout()

# Show the plots
plt.show()
```



Weather condition in the data set is describes as IMC and VMC. IMC is Instrument Metriological Condition. IMC occurs when there is poor visibility and the pilot uses Instrument Flight Rules(IFR). VMC is visual Metriological condition . VMC occurs when there is good visibility and the pilot uses Visual Flight Rules (VFR)

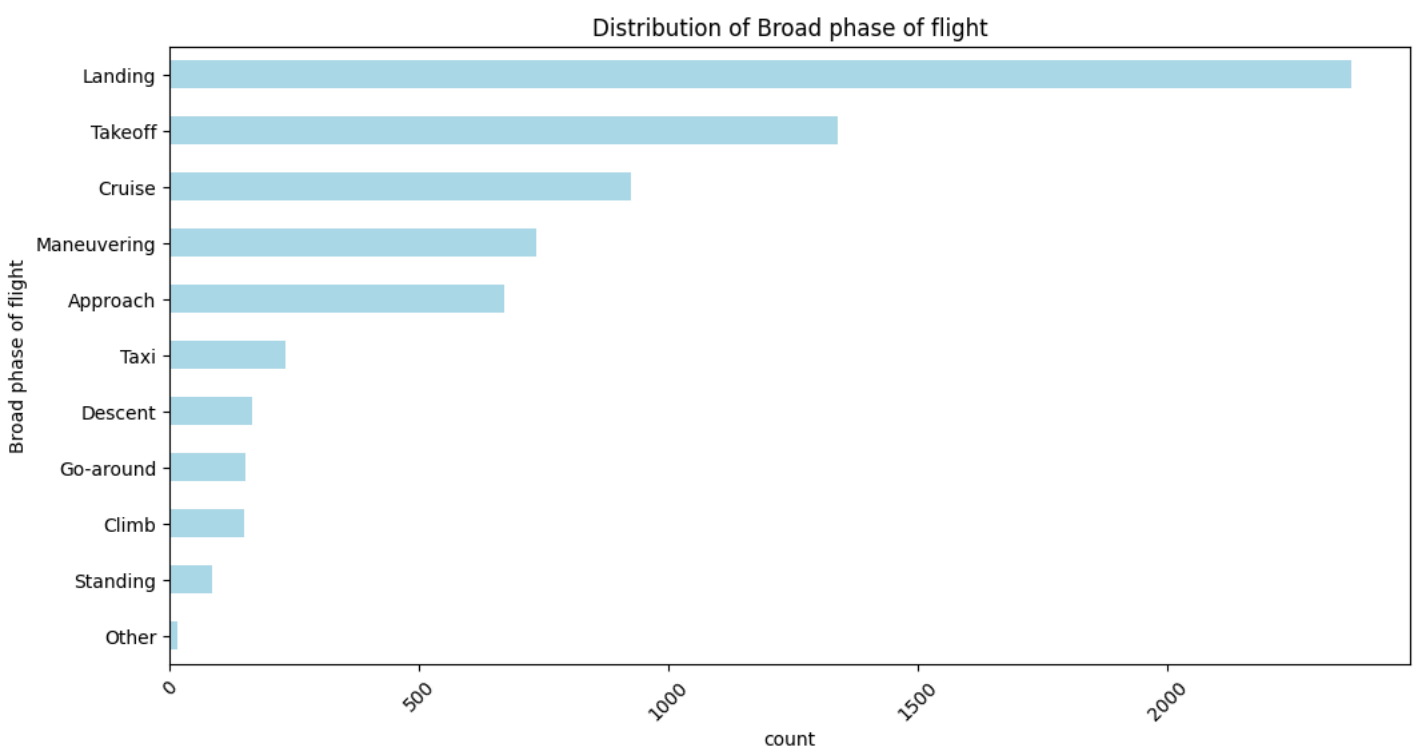
```
#Distribution of  weather condition values
fig, axes = plt.subplots(figsize=(12, 6))

#Plotting bar plot for Weather.Condition
usa_accidents_df['Weather.Condition'].value_counts().plot(kind = 'bar',ax=axes, grid=False)

# Clean up the labels
axes.set_xticklabels([label.strip("(),'") for label in usa_accidents_df['Weather.Condition'].value_counts().index])
axes.set_title(' Distribution of Weather Condition')
```

```
axes.set_xlabel('Weather Condition')
axes.set_ylabel('frequency')
axes.tick_params(axis='x', rotation=45)

# Adjust layout for better spacing
plt.tight_layout()

# Show the plots
plt.show()
```



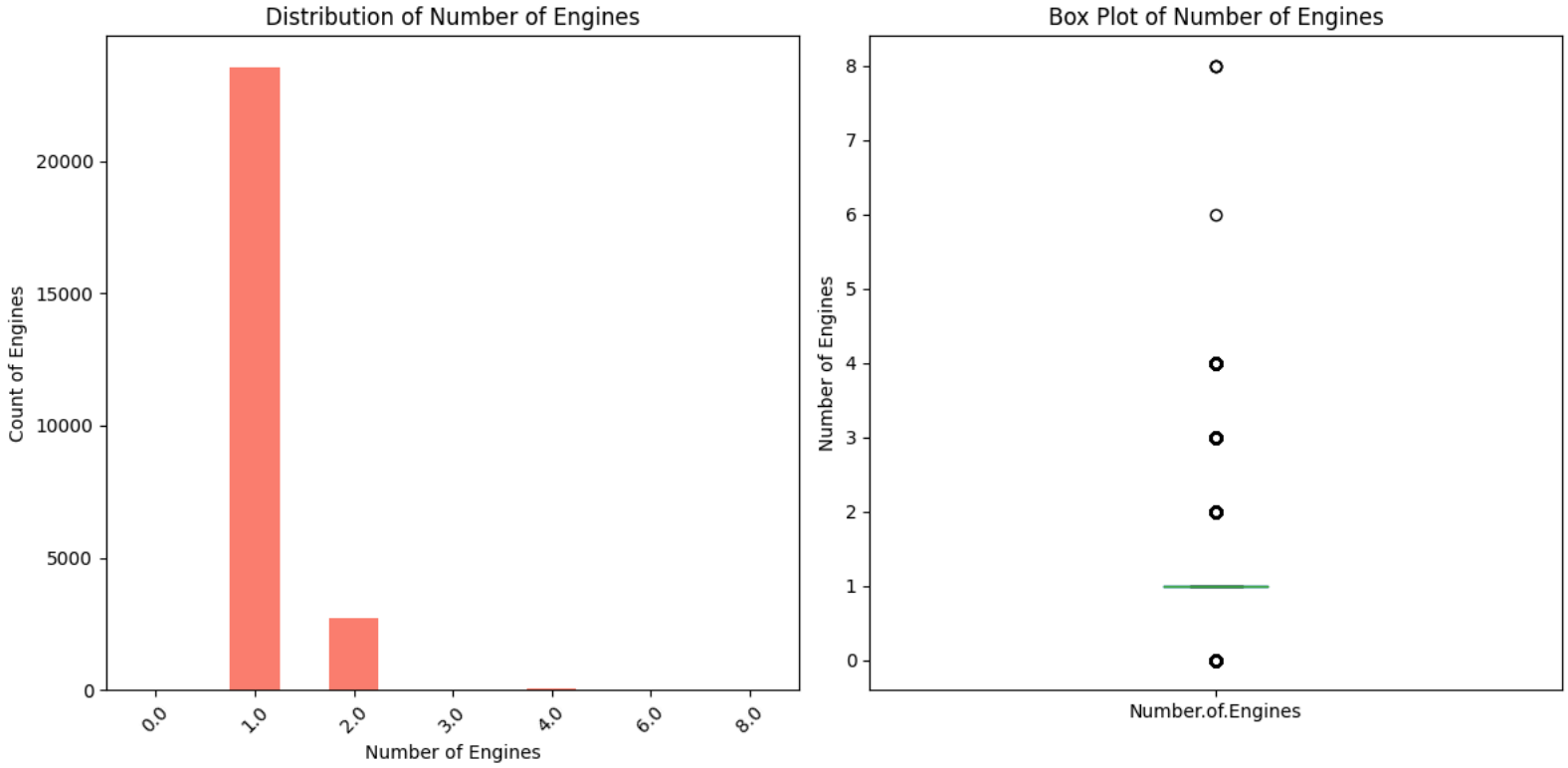

```
#Filter out 'Unknown' from 'Broad phase of flight'
df_phase_filtered = usa_accidents_df[usa_accidents_df['Broad.phase.of.flight'] != 'Unknown']

# Count the occurrences for the 'Broad phase of flight'
df_phase_counts = df_phase_filtered['Broad.phase.of.flight'].value_counts()

# Plotting the bar plot
fig, axes = plt.subplots(figsize=(12, 6))

df_phase_counts.plot(kind='barh', ax=axes, color='lightblue', grid=False)

# Set title and labels
axes.set_title('Distribution of Broad phase of flight')
axes.set_xlabel('count')
```

```
axes.set_ylabel('Broad phase of flight')

# Inverting the Y-axis to show the most frequent broad phase of flight at the top
axes.invert_yaxis()

# Adjust tick rotation
axes.tick_params(axis='x', rotation=45)
```




```
#Creating a figure with two subplots (one for bar and one for box plot for number of Engines)
fig, axes = plt.subplots(1, 2, figsize=(12, 6))

# Plotting Bar graph for Number of Engines
usa_accidents_df['Number.of.Engines'].value_counts().sort_index().plot(kind='bar', ax=axes[0], color='salmon', grid=False)

# Clean up the labels
axes[0].set_xticklabels([str(label).strip("(),'") for label in usa_accidents_df['Number.of.Engines'].value_counts().sort_index().index])

axes[0].set_title('Distribution of Number of Engines')
axes[0].set_xlabel('Number of Engines')
axes[0].set_ylabel('Count of Engines')

# Adjust tick rotation
axes[0].tick_params(axis='x', rotation=45)

# Plotting box plot for Number of Engines
```

```
df[['Number.of.Engines']].boxplot(ax=axes[1], grid=False)
axes[1].set_title('Box Plot of Number of Engines')
axes[1].set_ylabel('Number of Engines')

# Adjust layout for better spacing
plt.tight_layout()

# Show the plots
plt.show()

# Adjust tick rotation
axes[0].tick_params(axis='x', rotation=45)
```

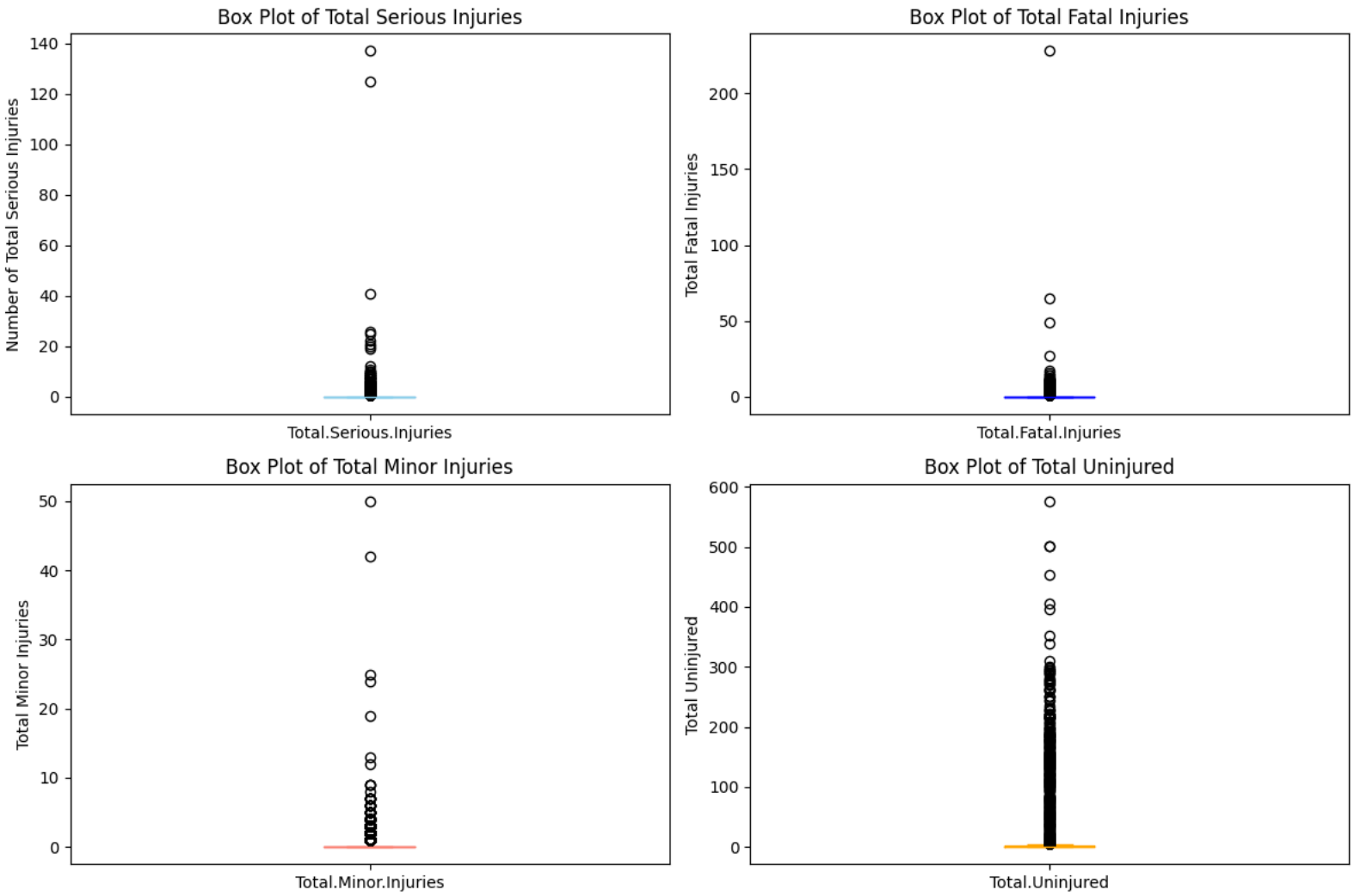



```
print(usa_accidents_df[['Total.Serious.Injuries', 'Total.Fatal.Injuries', 'Total.Minor.Injuries', 'Total.Uninjured']].dtypes)
```

```
Total.Serious.Injuries    float64
Total.Fatal.Injuries      float64
Total.Minor.Injuries      float64
Total.Uninjured           float64
dtype: object
```

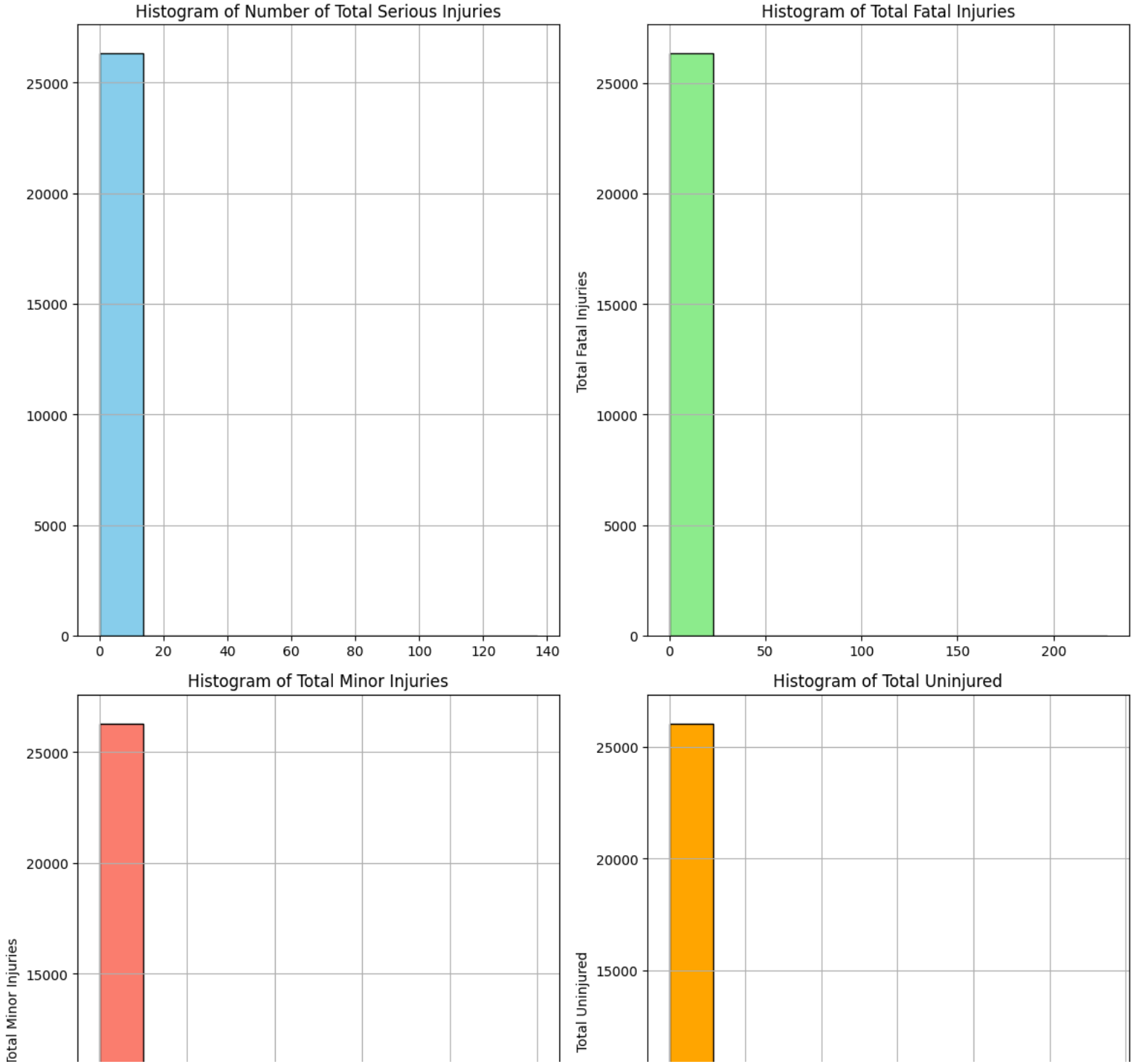
```
#Convert the 'Total.Fatal.Injuries' column to float
usa_accidents_df['Total.Fatal.Injuries'] = pd.to_numeric(usa_accidents_df['Total.Fatal.Injuries'], errors='coerce')
```

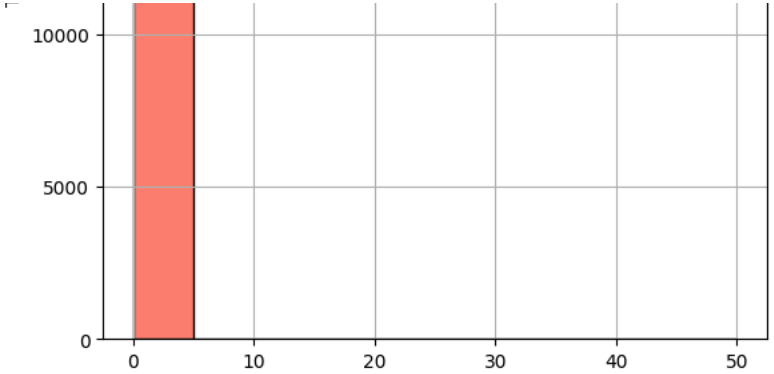
```
#Creating box plots for the various aviation accident injuries

fig, axes = plt.subplots(2, 2, figsize=(12, 8))

# Plotting box plot for Total Serious Injuries
usa_accidents_df[['Total.Serious.Injuries']].boxplot(ax=axes[0, 0], grid=False, color='skyblue')
axes[0, 0].set_title('Box Plot of Total Serious Injuries')
axes[0, 0].set_ylabel('Number of Total Serious Injuries')

# Plotting box plot for Total Fatal Injuries
usa_accidents_df[['Total.Fatal.Injuries']].boxplot(ax=axes[0, 1], grid=False, color='blue')
axes[0, 1].set_title('Box Plot of Total Fatal Injuries')
axes[0, 1].set_ylabel('Total Fatal Injuries')

# Plotting box plot forTotal MinorI njuries
usa_accidents_df[['Total.Minor.Injuries']].boxplot(ax=axes[1, 0], grid=False, color='salmon')
axes[1, 0].set_title('Box Plot of Total Minor Injuries')
axes[1, 0].set_ylabel('Total Minor Injuries')

usa_accidents_df[['Total.Uninjured']].boxplot(ax=axes[1, 1], grid=False, color='orange')
axes[1, 1].set_title('Box Plot of Total Uninjured')
axes[1, 1].set_ylabel('Total Uninjured')

# Adjust layout for better spacing
plt.tight_layout()

# Show the plots
plt.show()
```

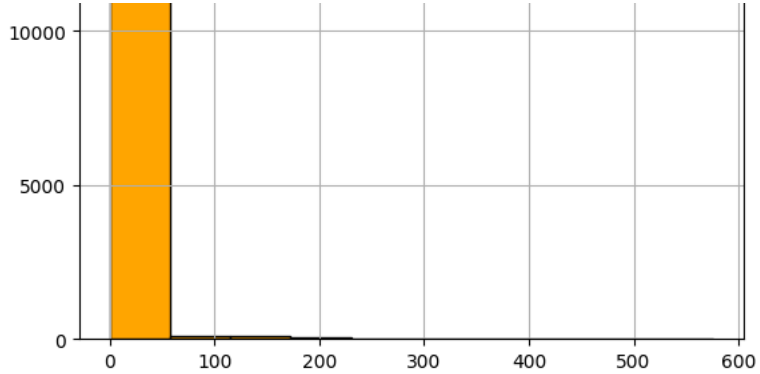



```
#Creating histogram for the various aviation injuries

fig, axes = plt.subplots(2, 2, figsize=(12, 14))

# Plotting box plot for Total Serious Injuries
usa_accidents_df[['Total.Serious.Injuries']].hist(ax=axes[0, 0], bins =10, edgecolor = 'black', color='skyblue')
axes[0, 0].set_title('Histogram of Number of Total Serious Injuries')

# Plotting box plot for Total Fatal Injuries
usa_accidents_df[['Total.Fatal.Injuries']].hist(ax=axes[0, 1], bins =10, edgecolor = 'black', color='lightgreen')
axes[0, 1].set_title('Histogram of Total Fatal Injuries')
axes[0, 1].set_ylabel('Total Fatal Injuries')

# Plotting box plot forTotal MinorI njuries
```

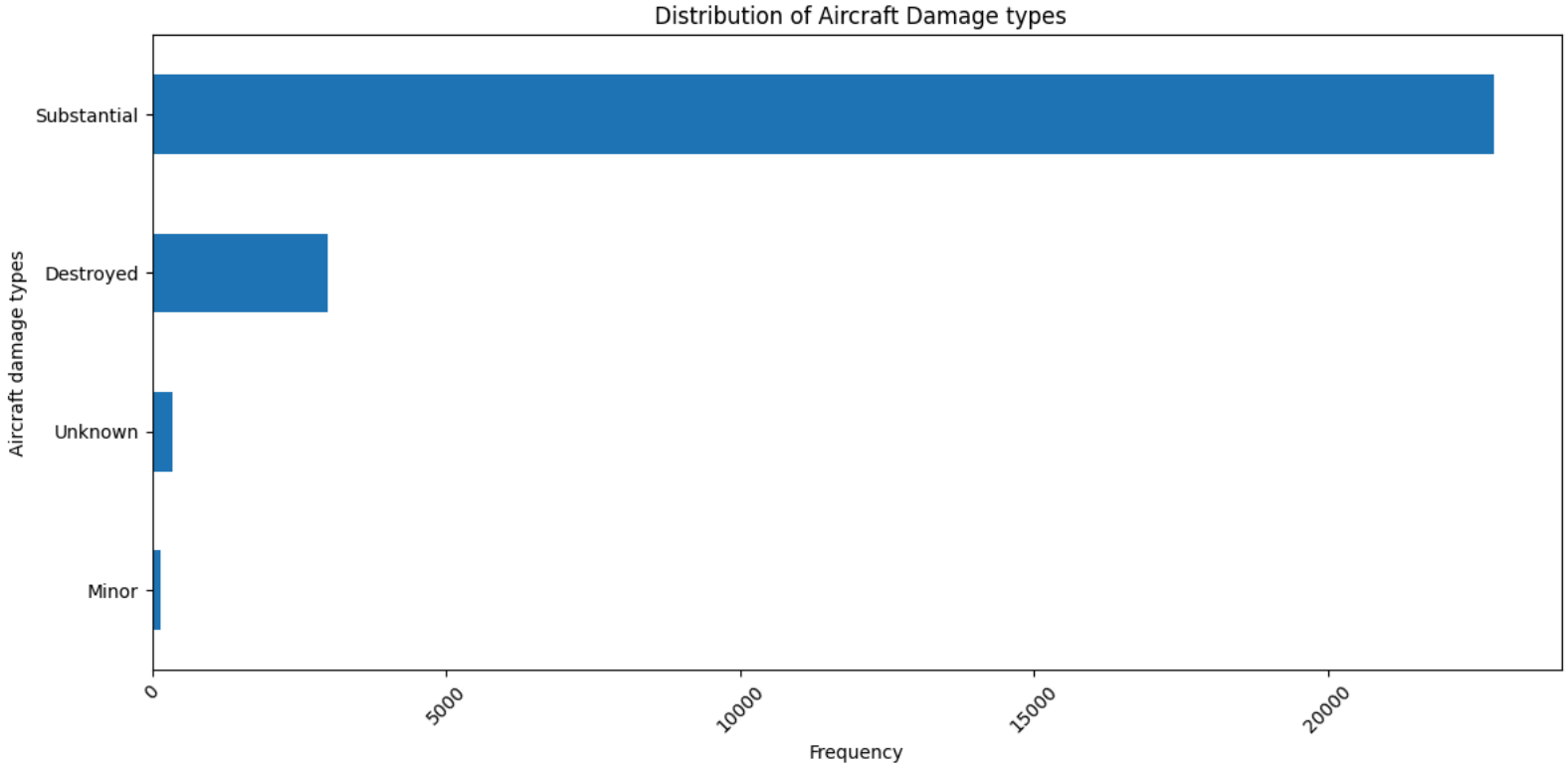
```
usa_accidents_df[['Total.Minor.Injuries']].hist(ax=axes[1, 0], bins =10, edgecolor = 'black', color='salmon')
axes[1, 0].set_title('Histogram of Total Minor Injuries')
axes[1, 0].set_ylabel('Total Minor Injuries')

# Plotting box plot for Total Uninjured
usa_accidents_df[['Total.Uninjured']].hist(ax=axes[1, 1], bins =10, edgecolor = 'black', color='orange')
axes[1, 1].set_title('Histogram of Total Uninjured')
axes[1, 1].set_ylabel('Total Uninjured')

# Adjust layout for better spacing
plt.tight_layout()

# Show the plots
plt.show()
```


Histogram of Number of Total Serious Injuries
Histogram of Total Fatal Injuries
Total Fatal Injuries
Histogram of Total Minor Injuries
Histogram of Total Uninjured
Total Uninjured
0
5000
10000
15000
20000
25000
0
20
40
60
80
100
120
140
0
50
100
150
200






```
# Distribution of Aircraft damage
fig, axes = plt.subplots(figsize=(12, 6))

#Plotting bar plot for Distribution of Aircraft Damage
usa_accidents_df['Aircraft.damage'].value_counts().plot(kind = 'barh',ax=axes, grid=False)

axes.set_title(' Distribution of Aircraft Damage types')
axes.set_xlabel('Frequency')
axes.set_ylabel('Aircraft damage types')
axes.tick_params(axis='x', rotation=45)

# Inverting the Y-axis to show the most frequent Aircraft damage type on the top
axes.invert_yaxis()

# Adjust layout for better spacing
plt.tight_layout()

# Show the plots
plt.show()
```



Bivariate analysis

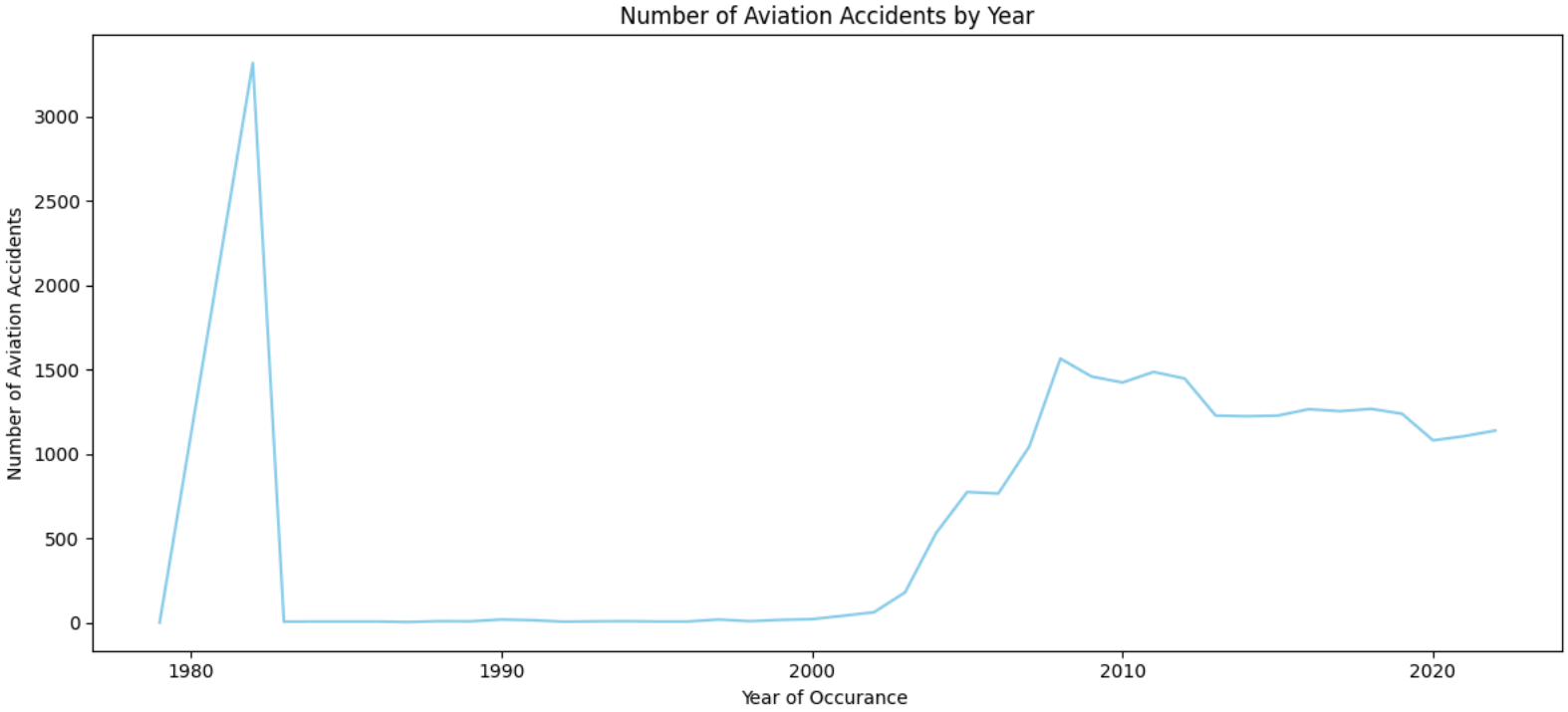
Number of Accidents Across years , months and weekdays

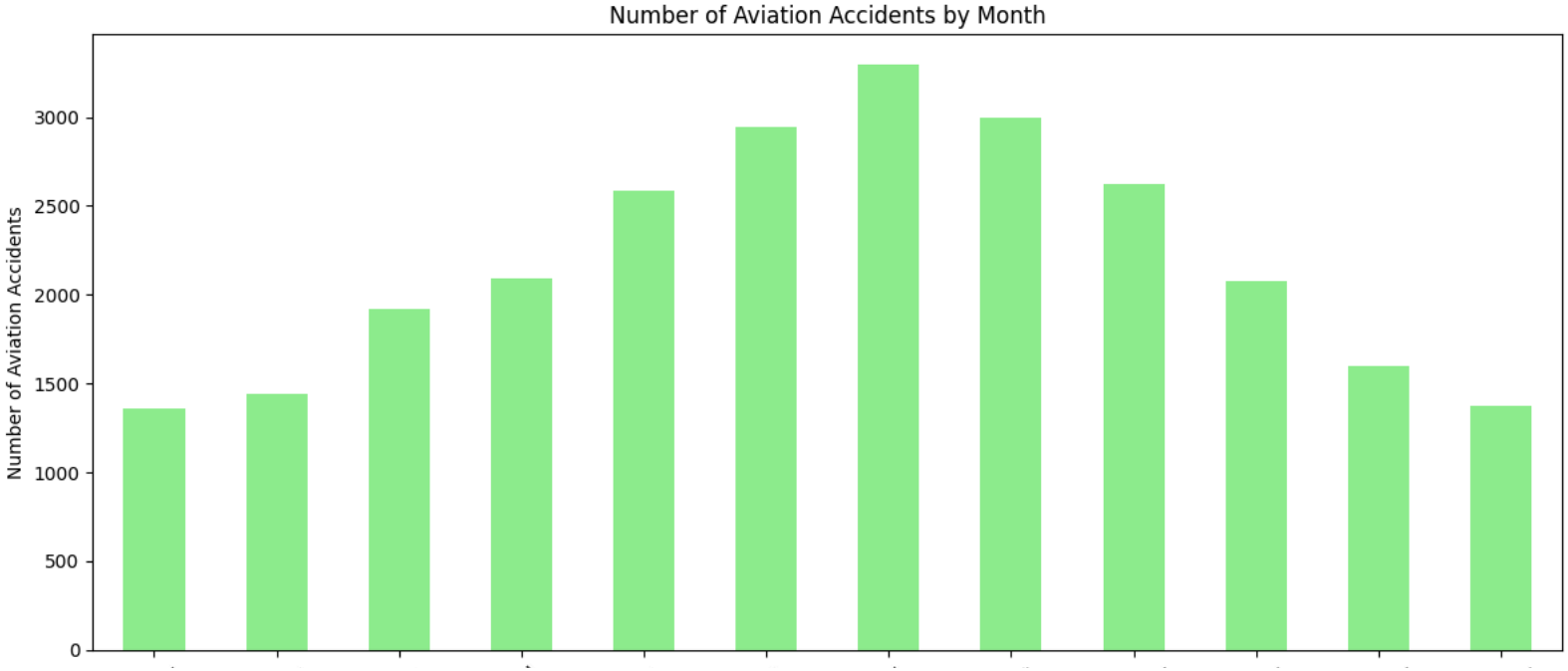
```
usa_accidents_df['Investigation.Type'].value_counts()
```

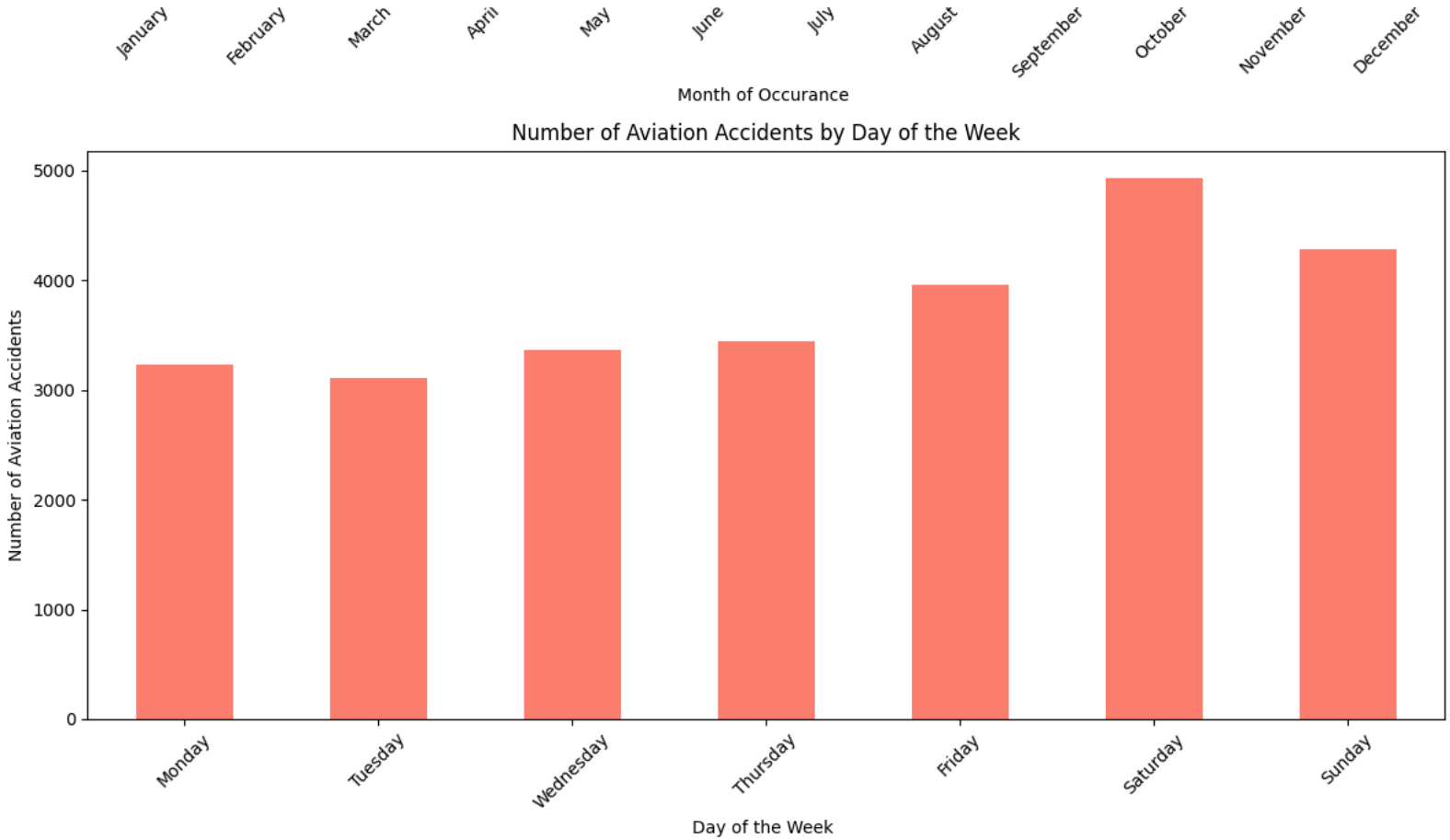
```
Investigation.Type
Accident    26324
Name: count, dtype: int64
```

```
#Grouping and counting per year
Accidents_by_Year= usa_accidents_df.groupby('Year').size()
Accidents_by_Month= usa_accidents_df.groupby('Month').size()
Accidents_by_Day = usa_accidents_df.groupby('Day').size()

#Reindexing
# Order the months and weekdays correctly
Accidents_by_Month = Accidents_by_Month.reindex(['January','February','March','April','May','June','July','August','September', 'October','November','December'])
Accidents_by_Day = Accidents_by_Day.reindex(['Monday','Tuesday','Wednesday','Thursday','Friday','Saturday','Sunday'])


# Plotting the number of aviation accidents per year , per month and per day
fig, axes = plt.subplots(3, 1, figsize=(12, 18))
```

```
#plot  Aviation Accidents by year
Accidents_by_Year.plot(kind='line', ax=axes[0], color='skyblue')
axes[0].set_title('Number of Aviation Accidents by Year')
axes[0].set_xlabel('Year of Occurance ')
axes[0].set_ylabel('Number of Aviation Accidents')

# Plot Aviation Accidents by Month

Accidents_by_Month.plot(kind='bar', ax=axes[1], color='lightgreen')
axes[1].set_title('Number of Aviation Accidents by Month')
axes[1].set_xlabel('Month of Occurance ')
axes[1].set_ylabel('Number of Aviation Accidents')
axes[1].tick_params(axis='x', rotation=45)

# Plot Aviation Accidents by Day

Accidents_by_Day.plot(kind='bar', ax=axes[2], color='salmon')
axes[2].set_title('Number of Aviation Accidents by Day of the Week')
axes[2].set_xlabel('Day of the Week ')
axes[2].set_ylabel('Number of Aviation Accidents')
axes[2].tick_params(axis='x', rotation=45)

# Adjust layout for better spacing

plt.tight_layout()

#show the plots
plt.show()
```

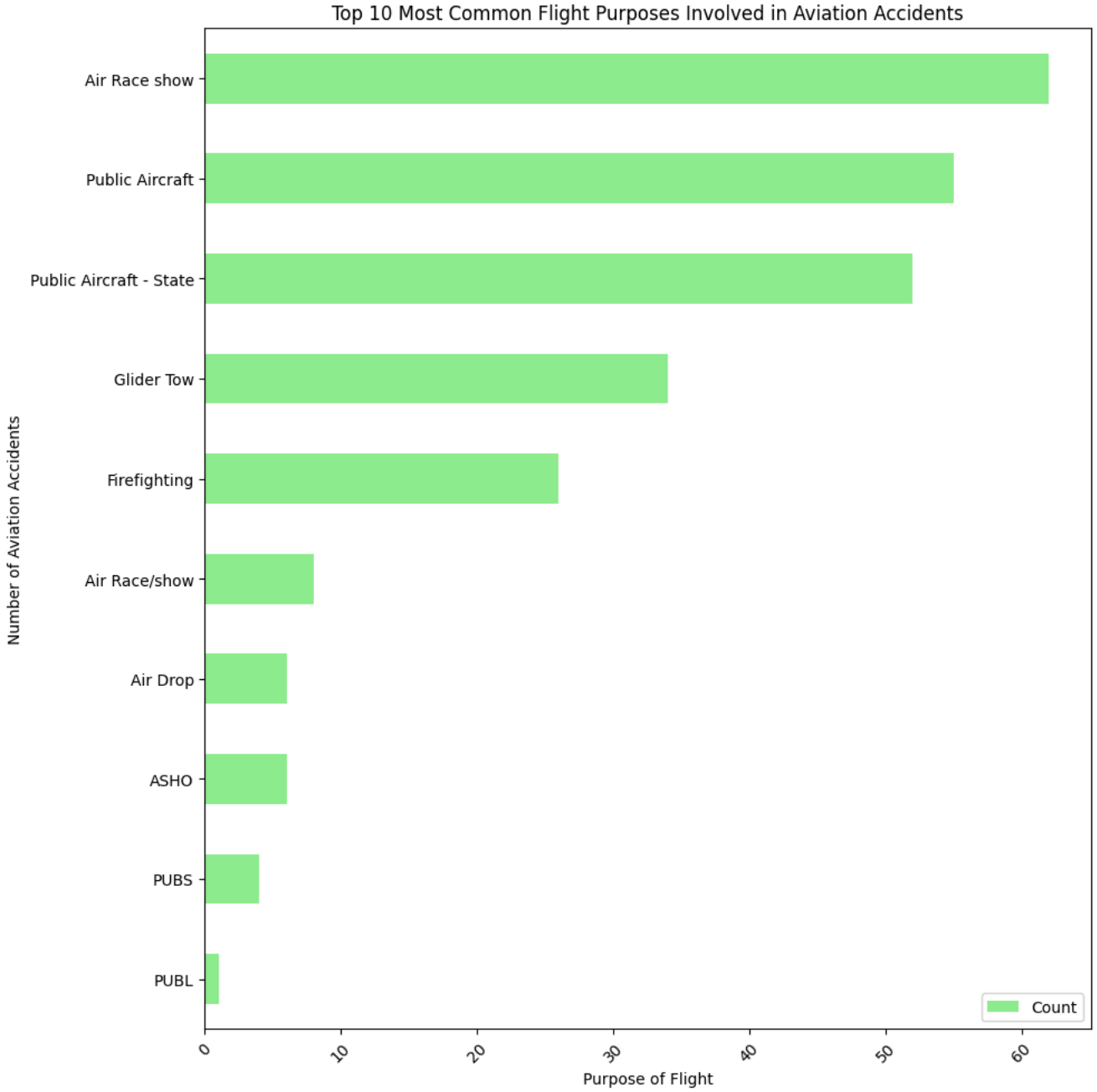

Number of Aviation Accidents by Year
Number of Aviation Accidents
0
500
1000
1500
2000
2500
3000
1980
1990
2000
2010
2020
Year of Occurance


Number of Aviation Accidents by Month
Number of Aviation Accidents
0
500
1000
1500
2000
2500
3000


January
February
March
April
May
June
July
August
September
October
November
December
Month of Occurance
Number of Aviation Accidents by Day of the Week
Number of Aviation Accidents
5000
4000
3000
2000
1000
0
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of the Week

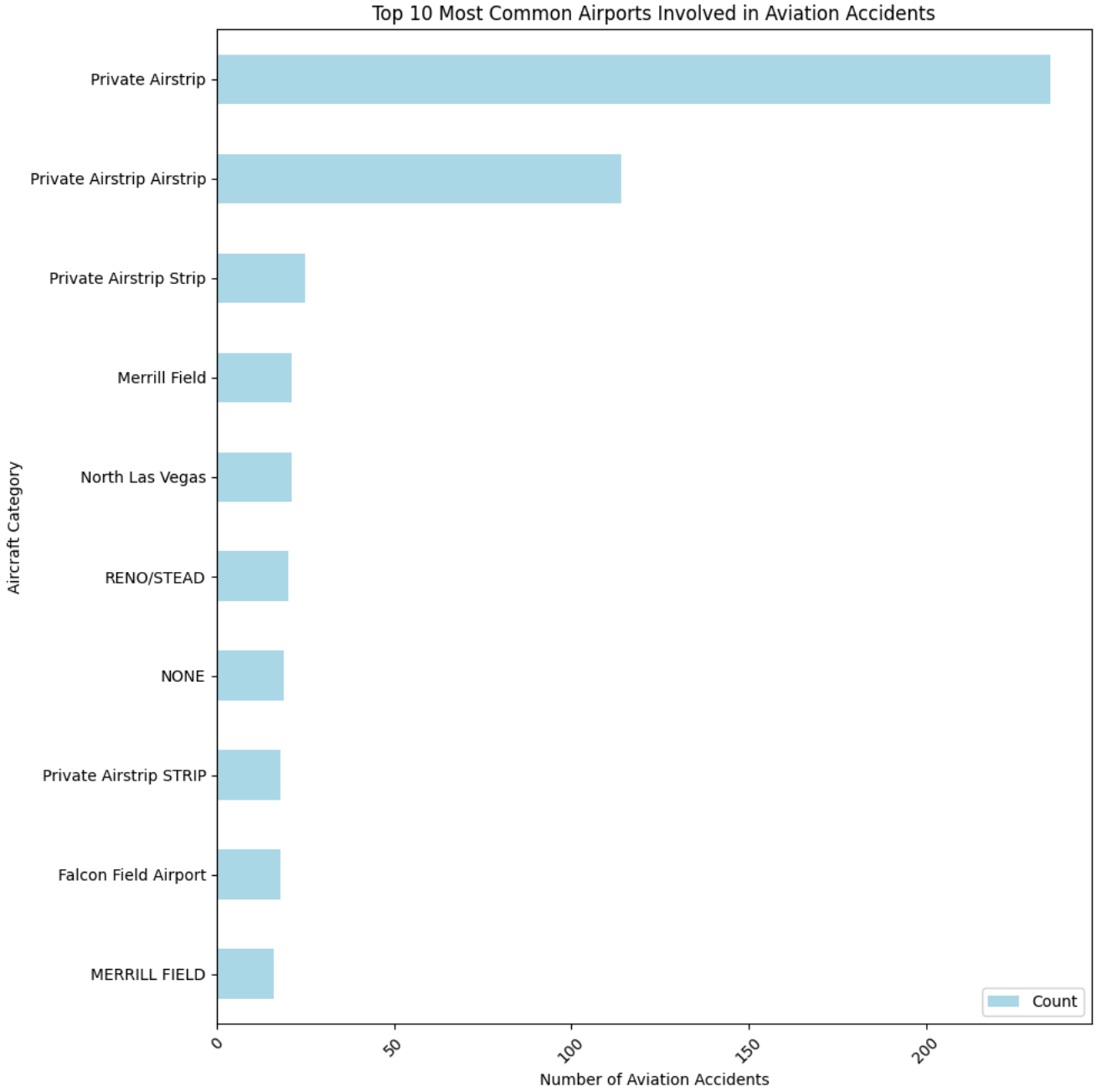
Exploring the purpose of flights involved in Aviation Accidents

```
#Remove rows where Purpose.of.flight is 'Unknown'
Total_Accidents = usa_accidents_df[usa_accidents_df['Purpose.of.flight'] != 'Unknown']

# Group data by "Purpose.of.flight"
Flight_purpose = Total_Accidents.groupby('Purpose.of.flight').size().reset_index(name='Count')

# Sorting the data by count in descending order
Flight_purpose_sorted = Flight_purpose.sort_values('Count', ascending= True)

# Displaying the top 10 most common flight purposes involved in accidents

Flight_purpose_sorted.head(10)

# Plotting the top 10 most common flight purposes involved in accidents
fig, axes = plt.subplots(figsize=(10, 10))
Flight_purpose_sorted[:10].plot(kind='barh', x='Purpose.of.flight', y='Count', ax=axes, color='lightgreen')
axes.set_title('Top 10 Most Common Flight Purposes Involved in Aviation Accidents')
axes.set_xlabel('Purpose of Flight')
axes.set_ylabel('Number of Aviation Accidents')
axes.tick_params(axis='x', rotation=45)

# Adjust layout for better spacing
plt.tight_layout()

#show the plots
plt.show()
```



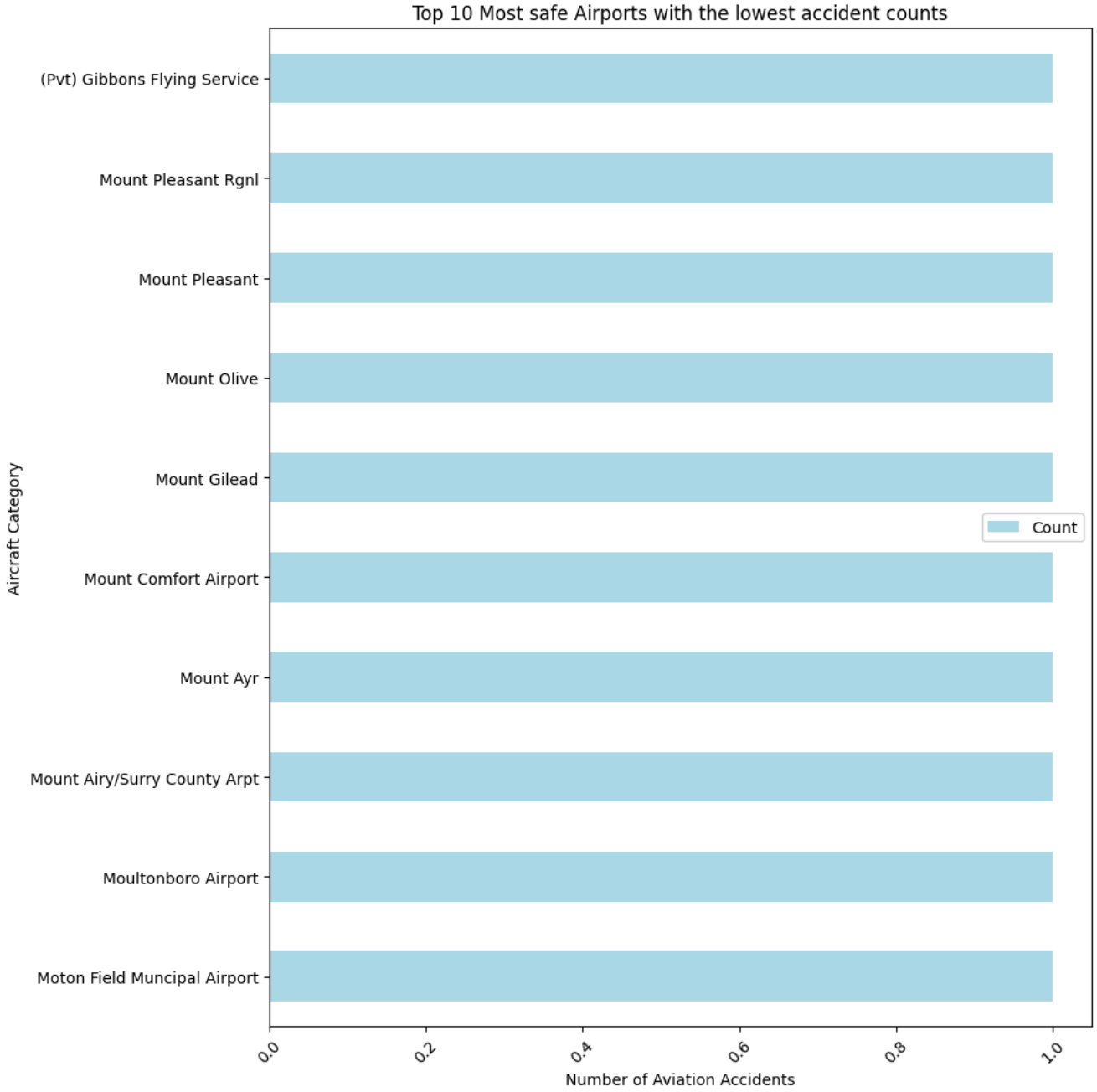
Exploring the Airports in USA involved in Aviation Accidents

```
#Remove rows where Airport.Name is 'Unknown'
Airport_Accidents = usa_accidents_df[usa_accidents_df['Airport.Name'] != 'Unknown']

# Group data by "Airport Name"
Airport_Name = Airport_Accidents.groupby('Airport.Name').size().reset_index(name='Count')

# Sorting the data by count in descending order
Airport_Name_sorted = Airport_Name.sort_values('Count', ascending= False)

# Displaying the top 10 most common airports involved in accidents
Airport_Name_sorted.head(20)

# Plotting the top 10 most common aircraft airports involved in Aviation Accidents
fig, axes = plt.subplots(figsize=(10, 10))
Airport_Name_sorted[:10].plot(kind='barh', x='Airport.Name', y='Count', ax=axes, color='lightblue')
axes.set_title('Top 10 Most Common Airports Involved in Aviation Accidents')
axes.set_xlabel('Number of Aviation Accidents')
axes.set_ylabel('Aircraft Category')
axes.tick_params(axis='x', rotation=45)

# Inverting the Y-axis to show the most frequent Airports involved in accidents on top
axes.invert_yaxis()

# Adjust layout for better spacing
plt.tight_layout()

#show the plots
plt.show()
```




```
#Remove rows where Airport.Name is 'Unknown'
Airport_Accidents = usa_accidents_df[usa_accidents_df['Airport.Name'] != 'Unknown']

# Group data by "Airport Name"
```

```
Airport_Name = Airport_Accidents.groupby('Airport.Name').size().reset_index(name='Count')

# Sorting the data by count in descending order
Airport_Name_sorted = Airport_Name.sort_values('Count', ascending= False)


# Filter for airports with at least 1 accident and at most 10 accidents, then sort by count in ascending order (safest airports)
Airport_Name_filtered = Airport_Name[(Airport_Name['Count'] <= 10) & (Airport_Name['Count'] > 0)].sort_values(by='Count', ascending=True)

# Plotting the top 10 safest airports
fig, axes = plt.subplots(figsize=(10, 10))
Airport_Name_filtered[:10].plot(kind='barh', x='Airport.Name', y='Count', ax=axes, color='lightblue')
axes.set_title('Top 10 Most safe Airports with the lowest accident counts')
axes.set_xlabel('Number of Aviation Accidents')
axes.set_ylabel('Aircraft Category')
axes.tick_params(axis='x', rotation=45)

# Inverting the Y-axis to show the most safe airports on top, with lowest accident counts
axes.invert_yaxis()

# Adjust layout for better spacing
plt.tight_layout()

#show the plots
plt.show()
```



Exploring make and model involved in aviation accidents

```
#Remove rows where Make is 'Unknown'
Total_Accidents = usa_accidents_df[usa_accidents_df['Make'] != 'Unknown']

# Group data by "Make" column
Make_clean = Total_Accidents.groupby('Make').size().reset_index(name='Count')

# Sorting the data by count in descending order
Make_sorted = Make_clean.sort_values('Count', ascending= False)

# Displaying the top 10 most common aviation Makes involved in accidents
Make_sorted.head(10)
```

	Make	Count
600	CESSNA	7638
2521	PIPER	4286
291	BEECH	1494
302	BELL	658
2260	MOONEY	387
380	BOEING	337
2748	ROBINSON	322
318	BELLANCA	279
1371	GRUMMAN	234
37	AERONCA	226

```
#Remove rows where Model is 'Unknown'
Total_Accidents = usa_accidents_df[usa_accidents_df['Model'] != 'Unknown']

# Group data by "Model" column
Model_clean = Total_Accidents.groupby('Model').size().reset_index(name='Count')

# Sorting the data by count in descending order
Model_sorted = Model_clean.sort_values('Count', ascending= False)

# Displaying the top 10 most common Aviation models  involved in accidents
Model_sorted.head(10)
```

	Model	Count
127	172	769
90	152	422
158	172N	304
200	182	287
165	172S	269
183	180	235
3612	PA28	230
73	150	223
3488	PA-28-140	219
157	172M	210

```
#Engine.Type
#Remove rows where Engine Type is 'Unknown'
Total_Accidents = usa_accidents_df[usa_accidents_df['Engine.Type'] != 'Unknown']

# Group data by "Engine.Type" column
Engine_Type_clean = Total_Accidents.groupby('Engine.Type').size().reset_index(name='Count')

# Sorting the data by count in descending order
Engine_Type_sorted = Engine_Type_clean.sort_values('Count', ascending= False)

# Displaying the top 10 most common Engine types involved in accidents
Engine_Type_sorted.head(10)
```

	Engine.Type	Count
1	Reciprocating	21374
4	Turbo Prop	1163
5	Turbo Shaft	1149
2	Turbo Fan	488
3	Turbo Jet	115
0	Electric	6
6	UNK	1

```
pilot_accidents = usa_accidents_df[usa_accidents_df['Air.carrier'] == 'Pilot']
category_counts = pilot_accidents['Aircraft.Category'].value_counts()
print(category_counts)
```

```
Aircraft.Category
Airplane      220
Helicopter     11
Name: count, dtype: int64
```