In [487…
```
# modules
# Platform
import os
import re

# analysis
import numpy as np
import pandas as pd

# visualizations
import seaborn as sns
import matplotlib.pyplot as plt
```

In [488…
```
# file path
file_path = r'data/AviationData.csv'
# dataframe
df = pd.read_csv(file_path, encoding='ISO-8859-1');
```

```
c:\Users\rurig\anaconda3\envs\learn-env\lib\site-packages\IPython\core\interactiveshell.py:3145: DtypeWarning: Columns (6,7,28) have mixed types.Specify dtype option on import or set low_memory=False.
  has_raised = await self.run_ast_nodes(code_ast.body, cell_name,
```

1. Shape

In [489…
```
df.shape # (88889, 31)
```

Out[489]:
```
(88889, 31)
```

2. Dataframe Basic Information

In [490…
```
# Check the first few rows
df.head(2)
```

Out[490]:

	Event.Id	Investigation.Type	Accident.Number	Event.Date	Location	Country	Latitude
0	20001218X45444	Accident	SEA87LA080	1948-10-24	MOOSE CREEK, ID	United States	NaN
1	20001218X45447	Accident	LAX94LA336	1962-07-19	BRIDGEPORT, CA	United States	NaN

2 rows × 31 columns

In [491…
```
# Check the last few rows
df.tail(2)
```

Out[491]:

	Event.Id	Investigation.Type	Accident.Number	Event.Date	Location	Country	Latitude
88887	20221227106498	Accident	WPR23LA076	2022-12-26	Morgan, UT	United States	NaN
88888	20221230106513	Accident	ERA23LA097	2022-12-29	Athens, GA	United States	NaN

2 rows × 31 columns

In [492…

```
# Get data types of each column
df.dtypes
```

Out[492]:

```
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
```

In [493…

```
# Get the number of columns
len(df.columns)
```

Out[493]:

```
31
```

In [494…

```
# Check for missing values
df.isnull().sum().to_frame()
```

Out[494]:

	0
Event.Id	0
Investigation.Type	0
Accident.Number	0
Event.Date	0
Location	52
Country	226
Latitude	54507
Longitude	54516
Airport.Code	38640
Airport.Name	36099
Injury.Severity	1000
Aircraft.damage	3194
Aircraft.Category	56602
Registration.Number	1317
Make	63
Model	92
Amateur.Built	102
Number.of.Engines	6084
Engine.Type	7077
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	6381
Publication.Date	13771

3. Summary Statistics

In [495…
```
# General statistics for numerical columns
df.describe()
```

Out[495]:

	Number.of.Engines	Total.Fatal.Injuries	Total.Serious.Injuries	Total.Minor.Injuries	Total.Uninjured
count	82805.000000	77488.000000	76379.000000	76956.000000	82977.00000(
mean	1.146585	0.647855	0.279881	0.357061	5.32544(
std	0.446510	5.485960	1.544084	2.235625	27.91363-
min	0.000000	0.000000	0.000000	0.000000	0.00000(
25%	1.000000	0.000000	0.000000	0.000000	0.00000(
50%	1.000000	0.000000	0.000000	0.000000	1.00000(
75%	1.000000	0.000000	0.000000	0.000000	2.00000(
max	8.000000	349.000000	161.000000	380.000000	699.00000(

4. Structure

In [496…
```
# Check for duplicate rows
df.duplicated().sum() # 0
```

Out[496]:
```
0
```

In [497…
```
df.columns.tolist()
```

Out[497]:
```
['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']
```

5. Missing Values and column analysis

In [498…
```python
col_list = list(df.columns)

for i in range(len(list(df.columns))):
    print(f"# column {i + 1} # {col_list[i]}")
```

```
# column 1 # Event.Id
# column 2 # Investigation.Type
# column 3 # Accident.Number
# column 4 # Event.Date
# column 5 # Location
# column 6 # Country
# column 7 # Latitude
# column 8 # Longitude
# column 9 # Airport.Code
# column 10 # Airport.Name
# column 11 # Injury.Severity
# column 12 # Aircraft.damage
# column 13 # Aircraft.Category
# column 14 # Registration.Number
# column 15 # Make
# column 16 # Model
# column 17 # Amateur.Built
# column 18 # Number.of.Engines
# column 19 # Engine.Type
# column 20 # FAR.Description
# column 21 # Schedule
# column 22 # Purpose.of.flight
# column 23 # Air.carrier
# column 24 # Total.Fatal.Injuries
# column 25 # Total.Serious.Injuries
# column 26 # Total.Minor.Injuries
# column 27 # Total.Uninjured
# column 28 # Weather.Condition
# column 29 # Broad.phase.of.flight
# column 30 # Report.Status
# column 31 # Publication.Date
```

In [499…

```
# Checking the number of missing values
# in each column
df.isnull().sum().to_frame()
df.isnull().sum().to_frame(name='null_count').sort_values(by='null_count', ascending=F
```

Out[499]:

	null_count
Schedule	76307
Air.carrier	72241
FAR.Description	56866
Aircraft.Category	56602
Longitude	54516
Latitude	54507
Airport.Code	38640
Airport.Name	36099
Broad.phase.of.flight	27165
Publication.Date	13771
Total.Serious.Injuries	12510
Total.Minor.Injuries	11933
Total.Fatal.Injuries	11401
Engine.Type	7077
Report.Status	6381
Purpose.of.flight	6192
Number.of.Engines	6084
Total.Uninjured	5912
Weather.Condition	4492
Aircraft.damage	3194
Registration.Number	1317
Injury.Severity	1000
Country	226
Amateur.Built	102
Model	92
Make	63
Location	52
Investigation.Type	0
Event.Date	0
Accident.Number	0
Event.Id	0

In [500…

```
# column 1 # Event.Id  #  type: object
df['Event.Id'].describe().to_frame()
df.duplicated(subset='Event.Id').sum() # 938
```

```
evt_id_inf = df['Event.Id'].describe().to_frame()

type(evt_id_inf.loc[evt_id_inf.index[0]][0])
evt_count = evt_id_inf.loc[evt_id_inf.index[0]][0]
evt_uniq = df['Event.Id'].nunique()
evt_mis = evt_count - 87951

print(
f'The Column count {evt_count},', # row 0
f'Number of unique values are {evt_uniq}.', # row 1
' ',
f'There are {evt_mis} missing values in "{list(df.columns)[0]}".', # missing
sep = '\n')

# df.drop_duplicates(inplace=True) # subset = 'Event.Id'
df.drop_duplicates(subset=['Event.Id'], inplace=True)

# Drop the column
df = df.drop(columns=['Event.Id'])
```

```
The Column count 88889,
Number of unique values are 87951.

There are 938 missing values in "Event.Id".
```

In [501…

```
# column 2 # 'Investigation.Type'  #  type: object
print(f"The values in the 'Investigation.Type' column are {df['Investigation.Type'].ur
      end = '\n\n')
df['Investigation.Type'].value_counts().to_frame()

for i in range(2):
    print(f"Investigation.Type '{df['Investigation.Type'].unique().tolist()[i]}' has {

# dropping 'Incident'
df = df.loc[(df['Investigation.Type'] == 'Accident')]
# Now, dropping the column
df = df.drop(columns=['Investigation.Type'])
```

```
The values in the 'Investigation.Type' column are ['Accident', 'Incident']

Investigation.Type 'Accident' has 95.72%
Investigation.Type 'Incident' has 4.28%
```

In [502…

```
# column 3 # Accident.Number
df['Accident.Number'].isnull().sum()
df['Accident.Number'].nunique() # 63011
# >>> dropping
df = df.drop(columns=['Accident.Number'])
```

In [503…

```
# column 4 # Event.Date
print(df['Event.Date'].dtype) # object
# check number of missing values
df['Event.Date'].isnull().sum()  # 0
# convert to datetime
df['Event.Date'] = pd.to_datetime(df['Event.Date'])
```

```
object
```

In [504…

```
# column 5 # Location
df.Location.isnull().sum() # 52
```

```
df.Location # number of rows # 87951
# >>> dropping
df.dropna(subset=['Location'], inplace=True)
```

In [505…

```
# column 6 # Country
df.Country.isnull().sum()
print(f"The shape if the dataframe is '{df.shape[0]}'.", sep = '\n\n')
# drop all null values in col
df = df.dropna(subset=['Country'])
print(f"""The shape of the new dataframe is {df.shape[0]}
Having lost 222""")
# comvert the name to title format
df['Country'] = df['Country'].apply(lambda x: x.title() if isinstance(x, str) else x)
# finding out which country stands out
df['Country'].value_counts().idxmax() # 'United States' with 79101 values
# percentage of USA
print()
print(f"Perc of null values: {df['Country'].value_counts()[0] / df.shape[0] * 100:.1f}
# # retaining only 'United States'
# df = df.loc[(df.Country == 'United States')]
```

```
The shape if the dataframe is '84150'.
The shape of the new dataframe is 83947
Having lost 222

Perc of null values: 94.2%
```

In [506…

```
# column 7 # Latitude # and
# column 8 # Longitude
# checking the dtype of Latitude and Longitude column
df.Longitude.dtype # dtype('O')
# inference
print(f"""There are \'{df['Latitude'].isnull().sum()}\' missing values in the latitude
whilst the longitude column has '{df['Longitude'].isnull().sum()}' missing values.""")
```

```
There are '50706' missing values in the latitude column,
whilst the longitude column has '50715' missing values.
```

In [507…

```
# Function to convert DMS to Decimal Degrees
def dms_to_dd(dms):
    if not isinstance(dms, str):  # Ensure input is a string
        return None  # Return None if it's NaN or not a string

    match = re.match(r"(\d{2,3})(\d{2})(\d{2})([NSWE])", dms)

    if not match:
        return None  # Return None if format is incorrect

    degrees, minutes, seconds, direction = match.groups()

    # Convert to decimal degrees
    decimal_degrees = int(degrees) + int(minutes) / 60 + int(seconds) / 3600

    # Apply negative sign for South and West coordinates
    if direction in ['S', 'W']:
        decimal_degrees *= -1

    return decimal_degrees
```

In [508…
```
# Apply conversion to both Latitude and Longitude columns
df['Latitude_DD'] = df['Latitude'].apply(dms_to_dd)
df['Longitude_DD'] = df['Longitude'].apply(dms_to_dd)

# Handling Null Values:
# Fill NaNs in converted columns
df.fillna({'Latitude_DD': 0, 'Longitude_DD': 0}, inplace=True)
# drop old cols
df.drop(columns=['Latitude', 'Longitude'], inplace=True)
```

In [509…
```
lat_long_rename = {'Latitude_DD': 'Latitude',
                   'Longitude_DD': 'Longitude'
                   }
df.rename(columns=lat_long_rename, inplace=True)
```

In [510…
```
# column 9 # Airport.Code
df['Airport.Code'].unique()
df['Airport.Code'].nunique()
df['Airport.Code'].value_counts()
df['Airport.Code'].isnull().sum() # 38144
df['Airport.Code'].isnull().sum() / df.shape[0] * 100 # 43.5% missing
# > > > dropping
df.drop(columns=['Airport.Code'], inplace = True)
```

In [511…
```
# column 10 # Airport.Name
# > > > dropping col
df.drop(columns=['Airport.Name'], inplace = True)
```

In [512…
```
# column 10 # Injury.Severity
df['Injury.Severity'].isnull().sum() # 50
df['Injury.Severity'].isnull().sum() / df.shape[0] * 100 # 0.06%
# drop the null values
df = df.dropna(subset=['Injury.Severity'])
df['Injury.Severity'].nunique() # 55
# df['Injury.Severity'].unique()
df['Injury.Severity'].value_counts().to_frame()
# drop the `Injury.Severity` column
df = df.drop(columns=['Injury.Severity'], axis=1)
```

In [513…
```
# column 11 # Aircraft.damage
df['Aircraft.damage'].unique()
df['Aircraft.damage'].value_counts().to_frame()
df['Aircraft.damage'].isnull().sum() / df.shape[0] * 100 # 1.38%
# >> dropping null values in columns
df.dropna(subset=['Aircraft.damage'], inplace=True)
df = df.loc[df['Aircraft.damage'] != 'Unknown']#['Aircraft.damage'].unique()
dict(df['Aircraft.damage'].value_counts())
```

Out[513]:
```
{'Substantial': 63296, 'Destroyed': 18228, 'Minor': 637}
```

In [514…
```
# column 12 # Aircraft.Category
df['Aircraft.Category'].isnull().sum() # 50958 values
# which is this perc
df['Aircraft.Category'].isnull().sum() / df.shape[0] * 100 # 65.3%
# dict
print(len(dict(df['Aircraft.Category'].value_counts())))
dict(df['Aircraft.Category'].value_counts())
```

```
# >>> dropping the entire col
# df = df.drop(columns=['Aircraft.Category'])
# fill null values with `unknown`
df['Aircraft.Category'].fillna('Unknown', inplace=True)
```

14

In [515…

```
# column 13 # Registration.Number
df['Registration.Number'].nunique() # 73624
# >>>
# dropping column
df.drop('Registration.Number', axis=1, inplace=True)
```

In [516…

```
# column 14 # Make
df.Make.nunique() # 8068
df.Make.value_counts()
# dropping column
# df.drop('Make', axis=1, inplace=True)
df = df.dropna(subset=['Make'])
```

In [517…

```
# column 15 # Model
df.Model.nunique() # 11353
# dropping column
df.drop('Model', axis=1, inplace=True)
```

In [518…

```
# column 16 # Amateur.Built
df['Amateur.Built'].nunique() # 3
# finding the value counts
dict(df['Amateur.Built'].value_counts()) # {'No': 69666, 'Yes': 8228}
# missing values
df['Amateur.Built'].isnull().sum() # 14
# dropping null values
df.dropna(subset=['Amateur.Built'], inplace=True)
```

In [519…

```
# column 13 # Number.of.Engines
df['Number.of.Engines'].unique().tolist() # [1.0, nan, 2.0, 0.0, 4.0, 3.0, 8.0, 6.0]
df['Number.of.Engines'].nunique() # 7
# perc of null values
df['Number.of.Engines'].isna().sum() / df.shape[0] * 100 # 5.04%
# drop null values
df = df.dropna(subset=['Number.of.Engines'])
# value counts
dict(df['Number.of.Engines'].value_counts()) # {1.0: 67017, 2.0: 8151, 0.0: 961, 4.0:
# Also, drop planes with 0 engines
# >>makes no sense for a plane with no engine
df = df.loc[(df['Number.of.Engines'] != 0.0)]
# Convert the dtype from `float64` to `int32`
df['Number.of.Engines'] = df['Number.of.Engines'].astype(int)
# checking the type
df['Number.of.Engines'].dtype # dtype('int32')
# print the new values types
df['Number.of.Engines'].unique() # array([1, 2, 4, 3, 8, 6])
```

Out[519]:

```
array([1, 2, 4, 3, 8, 6])
```

In [520…

```
# column 14 # Engine.Type
df['Engine.Type'].unique().tolist()
# >>>
```

```
# ['Reciprocating', 'Turbo Fan', 'Turbo Shaft', 'Turbo Prop', 'Turbo Jet', 'Unknown',
df['Engine.Type'].nunique() # 11
dict(df['Engine.Type'].value_counts())
# dropping column
df.drop('Engine.Type', axis=1, inplace=True)
```

In [521…

```
# column 15 # FAR.Description
# `
# FAR Desc -- Federal Aviation Regulations (FARs) set by the FAA, essentially
# outlining the aircraft's design and capabilities according to the regulatory
# standards for safe flight operations in the United States.
# `
df['FAR.Description'].nunique() # 27
df['FAR.Description'].value_counts()
df['FAR.Description'].unique()
# no of missing values
df['FAR.Description'].isnull().sum() # 49663
df['FAR.Description'].isnull().sum() / df.shape[0] * 100 # 65.8%
# dropping the column
df.drop('FAR.Description', axis=1, inplace=True)
```

In [522…

```
# column 16 # Schedule
df.Schedule.nunique() # 3
df.Schedule.unique() # array([nan, 'SCHD', 'NSCH', 'UNK'], dtype=object)
dict(df.Schedule.value_counts()) # {'UNK': 3721, 'NSCH': 3204, 'SCHD': 945}

df.Schedule.isnull().sum() # 68786
df.Schedule.isnull().sum() / df.shape[0] * 100 # 89.38%
# >>>
# dropping the columns
df.drop('Schedule', axis=1, inplace=True)
```

In [523…

```
# column 17 # Purpose.of.flight
df['Purpose.of.flight'].value_counts()
# dropping column
df.drop('Purpose.of.flight', axis=1, inplace=True)
```

In [524…

```
# column 18 # Air.carrier
df['Air.carrier'].isnull().sum() # 63242
# perc
df['Air.carrier'].isnull().sum() / df.shape[0] * 100 # 83.8%
# dropping col
df.drop('Air.carrier', axis=1, inplace=True)
```

In [525…

```
# column 19 # Total.Fatal.Injuries
df['Total.Fatal.Injuries'].isnull().sum() # 9702
# perc
df['Total.Fatal.Injuries'].isnull().sum() / df.shape[0] * 100 # 12.8%
# values
df['Total.Fatal.Injuries'].nunique() # 49
# specific
df['Total.Fatal.Injuries'].unique()
# drop null values
df.dropna(subset=['Total.Fatal.Injuries'], inplace=True)
# value count
dict(df['Total.Fatal.Injuries'].value_counts()) # {0.0: 51558, 1.0: 7402, 2.0: 4267, .
# reflect
df['Total.Fatal.Injuries'].unique()
```

```
# dtype
df['Total.Fatal.Injuries'].dtype
# converting from `float64` to `int32`
df['Total.Fatal.Injuries'] = df['Total.Fatal.Injuries'].astype(int)
# confirmation
df['Total.Fatal.Injuries'].dtype
```

Out[525]: dtype('int32')

In [526…

```
# column 20 # Total.Serious.Injuries
df['Total.Serious.Injuries'].isnull().sum() # 2045
# perc
df['Total.Serious.Injuries'].isnull().sum() / df.shape[0] * 100 # 3.11%
# drop null values
df.dropna(subset=['Total.Serious.Injuries'], inplace=True)
# values
df['Total.Serious.Injuries'].nunique() # 28
# specific
df['Total.Serious.Injuries'].unique()
# value count
dict(df['Total.Serious.Injuries'].value_counts()) # {0.0: 51558, 1.0: 7402, 2.0: 4267,
# reflect
df['Total.Serious.Injuries'].unique()
# # dtype
df['Total.Serious.Injuries'].dtype
# # converting from `float64` to `int32`
df['Total.Serious.Injuries'] = df['Total.Serious.Injuries'].astype(int)
# # confirmation
df['Total.Serious.Injuries'].dtype
```

Out[526]: dtype('int32')

In [527…

```
# column 21 # Total.Minor.Injuries
df['Total.Minor.Injuries'].isnull().sum() # 276
# # perc
df['Total.Minor.Injuries'].isnull().sum() / df.shape[0] * 100 # 0.43%
# # drop null values
df.dropna(subset=['Total.Minor.Injuries'], inplace=True)
# values
df['Total.Minor.Injuries'].nunique() # 40
# specific
df['Total.Minor.Injuries'].unique()
# value count
dict(df['Total.Minor.Injuries'].value_counts())
# reflect
df['Total.Minor.Injuries'].unique()
# dtype
df['Total.Minor.Injuries'].dtype
# # # converting from `float64` to `int32`
df['Total.Minor.Injuries'] = df['Total.Minor.Injuries'].astype(int)
# # # confirmation
df['Total.Minor.Injuries'].dtype
```

Out[527]: dtype('int32')

In [528…

```
# column 22 # Total.Uninjured
df['Total.Uninjured'].isnull().sum() # 43
# perc
```

```
df['Total.Uninjured'].isnull().sum() / df.shape[0] * 100 # 0.06%
# drop null values
df.dropna(subset=['Total.Uninjured'], inplace=True)
# dtype
df['Total.Uninjured'].dtype
# # # converting from `float64` to `int32`
df['Total.Uninjured'] = df['Total.Uninjured'].astype(int)
# # # confirmation
df['Total.Uninjured'].dtype
```

Out[528]:
```
dtype('int32')
```

In [529…
```
# column 23 # Weather.Condition
# no of unique values
df['Weather.Condition'].nunique() # 4
# the value count
dict(df['Weather.Condition'].value_counts()) # {'VMC': 58024, 'IMC': 4445, 'UNK': 478,
# null values
df['Weather.Condition'].isnull().sum() # 360
# perc
df['Weather.Condition'].isnull().sum() / df.shape[0] * 100 # 0.56%
# drop null values
df.dropna(subset=['Weather.Condition'], inplace=True)
```

In [530…
```
# column 24 # Broad.phase.of.flight
df['Broad.phase.of.flight'].isnull().sum() # 18668
# unique values
df['Broad.phase.of.flight'].unique()
# value count
df['Broad.phase.of.flight'].value_counts()

print(f"The composition of `unknown` and `other` is {(399 + 799) / df.shape[0] * 100:.
# fill null values with `Unknown`
df['Broad.phase.of.flight'] = df['Broad.phase.of.flight'].fillna('Unknown')
# replace 'Other' with 'Unknown'
df['Broad.phase.of.flight'] = df['Broad.phase.of.flight'].replace('Other', 'Unknown')
# #
dict(df['Broad.phase.of.flight'].value_counts())
# df.head(4)
```

Out[530]:
```
The composition of `unknown` and `other` is 1.88%
{'Unknown': 19694,
 'Landing': 10960,
 'Takeoff': 9386,
 'Cruise': 7613,
 'Maneuvering': 6198,
 'Approach': 4581,
 'Climb': 1394,
 'Descent': 1249,
 'Taxi': 1216,
 'Go-around': 1038,
 'Standing': 439}
```

In [531…
```
# column 25 # Report.Status
df['Report.Status'].nunique() # 15551
df.drop(columns=['Report.Status'], inplace=True)
```

In [532…
```
# column 26 # Publication.Date
# drop column entirely
```

```
df.drop(columns=['Publication.Date'], inplace=True)
```

In [533…

```
print(f"Now, there are {len(df.columns)} columns.")
# current columns are:-
df.columns
```

```
Now, there are 16 columns.
```

Out[533]:

```
Index(['Event.Date', 'Location', 'Country', 'Aircraft.damage',
       'Aircraft.Category', 'Make', 'Amateur.Built', 'Number.of.Engines',
       'Total.Fatal.Injuries', 'Total.Serious.Injuries',
       'Total.Minor.Injuries', 'Total.Uninjured', 'Weather.Condition',
       'Broad.phase.of.flight', 'Latitude', 'Longitude'],
      dtype='object')
```

In [534…

```
# check unique items
print(df.Location.nunique())

# filtering the abbrev
df['Location'] = df['Location'].map(lambda x: x[-2:].upper() if isinstance(x, str) els

# USA State abbreviations and full names
us_states = {
    "Alabama": "AL", "Alaska": "AK", "Arizona": "AZ", "Arkansas": "AR",
    "California": "CA", "Colorado": "CO", "Connecticut": "CT", "Delaware": "DE",
    "Florida": "FL", "Georgia": "GA", "Hawaii": "HI", "Idaho": "ID",
    "Illinois": "IL", "Indiana": "IN", "Iowa": "IA", "Kansas": "KS",
    "Kentucky": "KY", "Louisiana": "LA", "Maine": "ME", "Maryland": "MD",
    "Massachusetts": "MA", "Michigan": "MI", "Minnesota": "MN", "Mississippi": "MS",
    "Missouri": "MO", "Montana": "MT", "Nebraska": "NE", "Nevada": "NV",
    "New Hampshire": "NH", "New Jersey": "NJ", "New Mexico": "NM", "New York": "NY",
    "North Carolina": "NC", "North Dakota": "ND", "Ohio": "OH", "Oklahoma": "OK",
    "Oregon": "OR", "Pennsylvania": "PA", "Rhode Island": "RI", "South Carolina": "SC'
    "South Dakota": "SD", "Tennessee": "TN", "Texas": "TX", "Utah": "UT",
    "Vermont": "VT", "Virginia": "VA", "Washington": "WA", "West Virginia": "WV",
    "Wisconsin": "WI", "Wyoming": "WY"
}
# Inverting the dictionary to map abbreviations back to full state names
Abbrev_to_State = {state: abbrev for abbrev, state in us_states.items()}
# Replace abbreviations with full state names
df['Location'] = df['Location'].map(Abbrev_to_State).fillna(df['Location'])
# converting permanently
df.Location.unique()
```

```
20829
```

Out[534]:
```
array(['Idaho', 'California', 'Minnesota', 'Washington', 'New Jersey',
       'Florida', 'New Mexico', 'Alabama', 'Louisiana', 'Texas',
       'Oklahoma', 'Arkansas', 'Utah', 'Alaska', 'Pennsylvania',
       'Michigan', 'Georgia', 'Virginia', 'North Carolina', 'New York',
       'Montana', 'Oregon', 'Nevada', 'Indiana', 'Arizona', 'Missouri',
       'Wyoming', 'Illinois', 'South Carolina', 'Maryland', 'Ohio',
       'Hawaii', 'Colorado', 'Mississippi', 'DC', 'Vermont', 'Kansas',
       'New Hampshire', 'Iowa', 'Wisconsin', 'Massachusetts',
       'Connecticut', 'Kentucky', 'Tennessee', 'Maine', 'AN',
       'South Dakota', 'Nebraska', 'Rhode Island', 'North Dakota', 'LK',
       'West Virginia', '89', 'BO', 'Delaware', 'AS', 'FT', 'PR', 'OF',
       'EN', '95', 'OA', '98', 'DA', 'NG', 'ES', 'NA', 'EA', 'GU', 'OM',
       'DS', '74', 'O6', 'ZE', 'IC', '1A', 'CE', 'US', 'BA', 'GO', '67',
       '34', 'UA', 'TI', 'RU', 'LY', 'GM', '20', 'LI', 'EY', '16', 'I,',
       'NI', '9,', 'PO', 'AO', 'MY', '8,', 'O,', 'AQ', 'YA', 'N,', 'D,',
       'A,', 'AU', 'LE', 'ON', 'AY', 'JI', 'F)', ',', 'PE', 'S,', 'E,',
       'C,', 'UN', 'AD', 'H,', 'M,', 'G,', '7,', 'X,', 'OS', 'UM', 'CB',
       ', '], dtype=object)
```

In [535…
```
areas_of_interest = ['AS', 'FT', 'PR', 'OF',
       'EN', '95', 'OA', '98', 'DA', 'NG', 'ES', 'NA', 'EA', 'GU', 'OM',
       'DS', '74', 'O6', 'ZE', 'IC', '1A', 'CE', 'US', 'BA', 'GO', '67',
       '34', 'UA', 'TI', 'RU', 'LY', 'GM', '20', 'LI', 'EY', '16', 'I,',
       'NI', '9,', 'PO', 'AO', 'MY', '8,', 'O,', 'AQ', 'YA', 'N,', 'D,',
       'A,', 'AU', 'LE', 'ON', 'AY', 'JI', 'F)', ',', 'PE', 'S,', 'E,',
       'C,', 'UN', 'AD', 'H,', 'M,', 'G,', '7,', 'X,', 'OS', 'UM', 'CB',
       ', ']

df.loc[(df.Location.isin(areas_of_interest))]['Country'].unique()
df.loc[df.Country != 'United States']
```

Out[535]:

	Event.Date	Location	Country	Aircraft.damage	Aircraft.Category	Make	Amateur.Built
237	1982-02-04	Colorado	Gulf Of Mexico	Substantial	Helicopter	Bell	No
333	1982-02-15	AN	Puerto Rico	Substantial	Airplane	Cessna	No
402	1982-02-23	AN	Atlantic Ocean	Destroyed	Airplane	Cessna	No
463	1982-03-02	LK	High Island	Destroyed	Helicopter	Bell	No
1391	1982-05-29	89	High Island	Destroyed	Helicopter	Bell	No
...	...	...	...	...	...	...	...
87750	2022-04-30	OF	Venezuela	Substantial	Airplane	ROCKWELL	No
87755	2022-05-01	,	Bolivia	Substantial	Airplane	CESSNA	No
87823	2022-05-20	OF	Venezuela	Destroyed	Airplane	CESSNA	No
88712	2022-10-23	OF	Argentina	Destroyed	Airplane	CESSNA	No
88837	2022-12-01	OF	Cuba	Substantial	Airplane	LEARJET	No

765 rows × 16 columns

In [536…

```
# inference
# Colorado is not in the Gulf of Mexico
df.loc[df['Location'] == 'Colorado', 'Country'] = 'United States'
df.loc[df.Country != 'United States']
```

Out[536]:

	Event.Date	Location	Country	Aircraft.damage	Aircraft.Category	Make	Amateur.Built
333	1982-02-15	AN	Puerto Rico	Substantial	Airplane	Cessna	No
402	1982-02-23	AN	Atlantic Ocean	Destroyed	Airplane	Cessna	No
463	1982-03-02	LK	High Island	Destroyed	Helicopter	Bell	No
1391	1982-05-29	89	High Island	Destroyed	Helicopter	Bell	No
1444	1982-06-03	BO	Puerto Rico	Substantial	Airplane	Cessna	No
...	...	...	...	...	...	...	...
87750	2022-04-30	OF	Venezuela	Substantial	Airplane	ROCKWELL	No
87755	2022-05-01	,	Bolivia	Substantial	Airplane	CESSNA	No
87823	2022-05-20	OF	Venezuela	Destroyed	Airplane	CESSNA	No
88712	2022-10-23	OF	Argentina	Destroyed	Airplane	CESSNA	No
88837	2022-12-01	OF	Cuba	Substantial	Airplane	LEARJET	No

703 rows × 16 columns

In [537…
```
df.Country.value_counts()
```

Out[537]:
```
United States                  63065
Bahamas                           82
Atlantic Ocean                    54
Puerto Rico                       52
Brazil                            50
                                ...
Trinidad And Tobago                1
Chad                               1
Iceland                            1
Costa Rica                         1
Federated States Of Micronesia     1
Name: Country, Length: 104, dtype: int64
```

In [538…
```
# generating columns number
# for ease of analysis
col_list = list(df.columns)
# for-loop
for i in range(len(list(df.columns))):
    print(f"# column {i + 1} # {col_list[i]}")
```

```
# column 1 # Event.Date
# column 2 # Location
# column 3 # Country
# column 4 # Aircraft.damage
# column 5 # Aircraft.Category
# column 6 # Make
# column 7 # Amateur.Built
# column 8 # Number.of.Engines
# column 9 # Total.Fatal.Injuries
# column 10 # Total.Serious.Injuries
# column 11 # Total.Minor.Injuries
# column 12 # Total.Uninjured
# column 13 # Weather.Condition
# column 14 # Broad.phase.of.flight
# column 15 # Latitude
# column 16 # Longitude
```

In [539…

```
# grimpse so far..
df.head(3)
```

Out[539]:

	Event.Date	Location	Country	Aircraft.damage	Aircraft.Category	Make	Amateur.Built	Numbe
0	1948-10-24	Idaho	United States	Destroyed	Unknown	Stinson	No	
1	1962-07-19	California	United States	Destroyed	Unknown	Piper	No	
3	1977-06-19	California	United States	Destroyed	Unknown	Rockwell	No	

In [540…

```
df.Country.unique()
df.Country.value_counts()[:10]
```

Out[540]:

```
United States     63065
Bahamas              82
Atlantic Ocean       54
Puerto Rico          52
Brazil               50
Pacific Ocean        34
Colombia             28
Canada               28
Missing              23
Australia            18
Name: Country, dtype: int64
```

Descriptive Analysis

In [541…

```
# number of columns
print(f'The Number of columns are: {len(df.columns)}')
# columns are:-
print(f'The columns are:- ')
list(df.columns)
```

```
The Number of columns are: 16
The columns are:-
```

Out[541]:
```
['Event.Date',
 'Location',
 'Country',
 'Aircraft.damage',
 'Aircraft.Category',
 'Make',
 'Amateur.Built',
 'Number.of.Engines',
 'Total.Fatal.Injuries',
 'Total.Serious.Injuries',
 'Total.Minor.Injuries',
 'Total.Uninjured',
 'Weather.Condition',
 'Broad.phase.of.flight',
 'Latitude',
 'Longitude']
```

In [542…
```
# the shape of the dataframe
df.shape
```

Out[542]:
```
(63768, 16)
```

In [543…
```
# description
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 63768 entries, 0 to 88886
Data columns (total 16 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   Event.Date              63768 non-null  datetime64[ns]
 1   Location                63768 non-null  object
 2   Country                 63768 non-null  object
 3   Aircraft.damage         63768 non-null  object
 4   Aircraft.Category       63768 non-null  object
 5   Make                    63768 non-null  object
 6   Amateur.Built           63768 non-null  object
 7   Number.of.Engines       63768 non-null  int32
 8   Total.Fatal.Injuries    63768 non-null  int32
 9   Total.Serious.Injuries  63768 non-null  int32
 10  Total.Minor.Injuries    63768 non-null  int32
 11  Total.Uninjured         63768 non-null  int32
 12  Weather.Condition       63768 non-null  object
 13  Broad.phase.of.flight   63768 non-null  object
 14  Latitude                63768 non-null  float64
 15  Longitude               63768 non-null  float64
dtypes: datetime64[ns](1), float64(2), int32(5), object(8)
memory usage: 7.1+ MB
```

In [544…
```
# rename the columns
columns={'Event.Date': 'Date',
         'Make': 'Manufacturer',
         'Number.of.Engines': 'Engines',
         'Aircraft.damage': 'DamageLevel',
         'Amateur.Built': 'Built',
         'Aircraft.Category': 'TypeOfAircraft',
         'Total.Fatal.Injuries': 'Fatal-Injuries',
         'Total.Serious.Injuries': 'Serious-Injuries',
         'Total.Minor.Injuries': 'Minor-Injuries',
         'Total.Uninjured': 'Uninjured',
```

```
         'Weather.Condition': 'Weather-Condition',
         'Broad.phase.of.flight': 'Flight.Phase'
         }

df = df.rename(columns=columns)
list(df.columns)
```

Out[544]:
```
['Date',
 'Location',
 'Country',
 'DamageLevel',
 'TypeOfAircraft',
 'Manufacturer',
 'Built',
 'Engines',
 'Fatal-Injuries',
 'Serious-Injuries',
 'Minor-Injuries',
 'Uninjured',
 'Weather-Condition',
 'Flight.Phase',
 'Latitude',
 'Longitude']
```

In [545…
```
#  check num dtype
df[['Fatal-Injuries', 'Serious-Injuries', 'Minor-Injuries', 'Uninjured']].describe()
# creating a new column
df['Passengers'] = df[['Fatal-Injuries', 'Serious-Injuries', 'Minor-Injuries', 'Uninju
# columns
df.columns
# rearranging columns
df = df[['Date', 'Location', 'Country', 'DamageLevel', 'TypeOfAircraft', 'Manufacturer
       'Built', 'Engines', 'Passengers', 'Fatal-Injuries', 'Serious-Injuries',
       'Minor-Injuries', 'Uninjured', 'Weather-Condition', 'Flight.Phase',
       'Latitude', 'Longitude']]

# checking order of columns
df.columns
```

Out[545]:
```
Index(['Date', 'Location', 'Country', 'DamageLevel', 'TypeOfAircraft',
       'Manufacturer', 'Built', 'Engines', 'Passengers', 'Fatal-Injuries',
       'Serious-Injuries', 'Minor-Injuries', 'Uninjured', 'Weather-Condition',
       'Flight.Phase', 'Latitude', 'Longitude'],
      dtype='object')
```

In [546…
```
# value_counts of manufacture column
# inference
# ----------
# some names are not consistent
# ----------
print(f"""Before:-
----------------------
{df.Manufacturer.value_counts().to_frame()[:10]}""",
end='\n\n')

# Capitalize the first letter of each word in 'Manufacturer' column
df['Manufacturer'] = df['Manufacturer'].str.lower().str.title()
# confirming
print("""After:-
----------------------""")
print(df.Manufacturer.value_counts().to_frame()[:10])
```

```
Before:-
----------------------
          Manufacturer
Cessna           17286
Piper             9383
CESSNA            4128
Beech             3195
PIPER             2443
Bell              1453
Grumman            947
BEECH              839
Mooney             822
Bellanca           728

After:-
----------------------
          Manufacturer
Cessna           21414
Piper            11826
Beech             4034
Bell              1848
Mooney            1029
Grumman           1011
Bellanca           875
Hughes             706
Robinson           637
Aeronca            531
```

Desciptional Analysis 2

In [547…

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 63768 entries, 0 to 88886
Data columns (total 17 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   Date               63768 non-null  datetime64[ns]
 1   Location           63768 non-null  object
 2   Country            63768 non-null  object
 3   DamageLevel        63768 non-null  object
 4   TypeOfAircraft     63768 non-null  object
 5   Manufacturer       63768 non-null  object
 6   Built              63768 non-null  object
 7   Engines            63768 non-null  int32
 8   Passengers         63768 non-null  int64
 9   Fatal-Injuries     63768 non-null  int32
 10  Serious-Injuries   63768 non-null  int32
 11  Minor-Injuries     63768 non-null  int32
 12  Uninjured          63768 non-null  int32
 13  Weather-Condition  63768 non-null  object
 14  Flight.Phase       63768 non-null  object
 15  Latitude           63768 non-null  float64
 16  Longitude          63768 non-null  float64
dtypes: datetime64[ns](1), float64(2), int32(5), int64(1), object(8)
memory usage: 7.5+ MB
```

In [548…
```
# Description
df.describe()
```

Out[548]:

	Engines	Passengers	Fatal-Injuries	Serious-Injuries	Minor-Injuries	Uninjured	Latit
count	63768.000000	63768.000000	63768.000000	63768.000000	63768.000000	63768.000000	63768.000
mean	1.118774	2.659814	0.400687	0.222478	0.281599	1.755050	8.075
std	0.349752	11.943647	2.769290	1.104898	1.257196	11.168593	15.883
min	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	-48.571
25%	1.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000
50%	1.000000	2.000000	0.000000	0.000000	0.000000	1.000000	0.000
75%	1.000000	2.000000	0.000000	0.000000	0.000000	2.000000	3.993
max	8.000000	576.000000	270.000000	137.000000	125.000000	576.000000	71.474

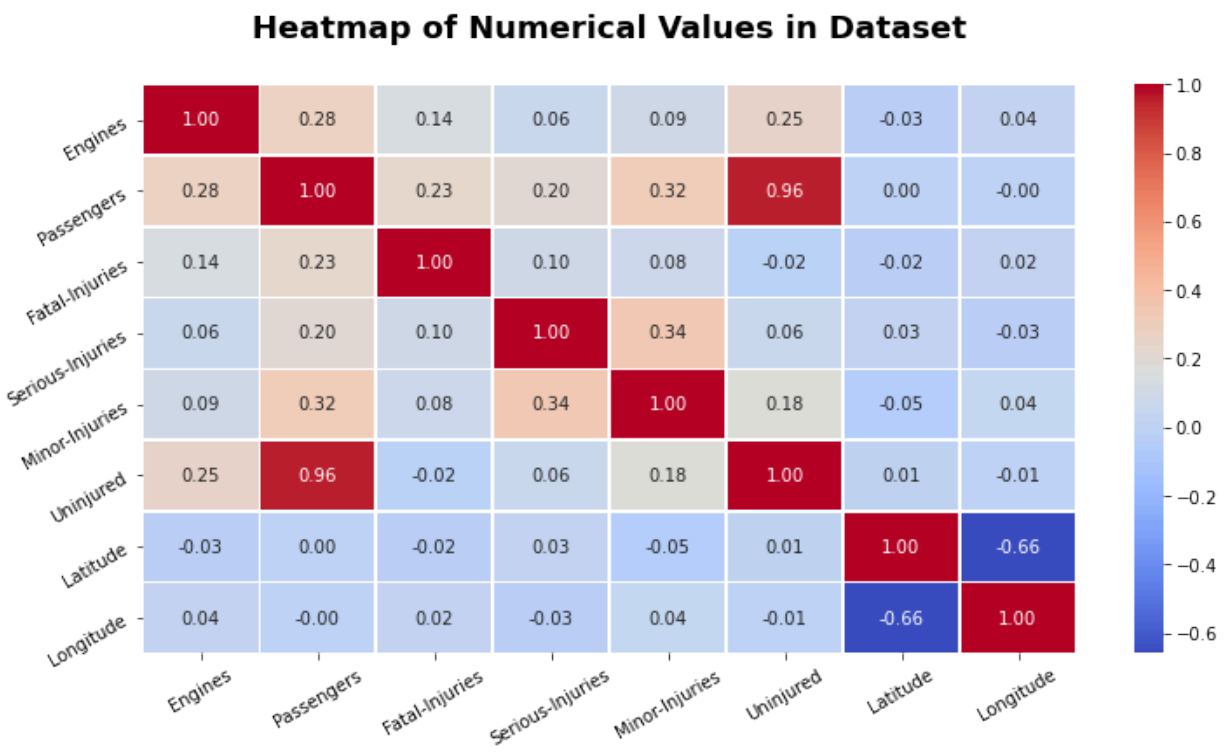
In [549…
```
# Corr-Matrix
df.corr()
```

Out[549]:

	Engines	Passengers	Fatal-Injuries	Serious-Injuries	Minor-Injuries	Uninjured	Latitude	Longitude
Engines	1.000000	0.284867	0.139910	0.055594	0.089097	0.254416	-0.034466	0.037014
Passengers	0.284867	1.000000	0.233736	0.204158	0.321414	0.955063	0.003639	-0.000610
Fatal-Injuries	0.139910	0.233736	1.000000	0.098033	0.082217	-0.016950	-0.018851	0.018118
Serious-Injuries	0.055594	0.204158	0.098033	1.000000	0.340731	0.056735	0.028131	-0.028428
Minor-Injuries	0.089097	0.321414	0.082217	0.340731	1.000000	0.177059	-0.045173	0.042025
Uninjured	0.254416	0.955063	-0.016950	0.056735	0.177059	1.000000	0.010867	-0.007063
Latitude	-0.034466	0.003639	-0.018851	0.028131	-0.045173	0.010867	1.000000	-0.660415
Longitude	0.037014	-0.000610	0.018118	-0.028428	0.042025	-0.007063	-0.660415	1.000000

In [550…
```
# corr matrix
corr_matrix = df.corr()

# figure size
plt.figure(figsize=(12, 6))  # w, h
# heatmap
sns.heatmap(corr_matrix, annot=True, cmap='coolwarm', fmt='.2f', linewidths=0.5)

# Rotation of the axis labels
plt.xticks(rotation=30)
plt.yticks(rotation=30)
```

```
# Labels
plt.title('\nHeatmap of Numerical Values in Dataset\n', fontsize=18, fontweight='bold'

# teh Plot
plt.show();
```



Visualizations

In [551…

```
df.columns
```

Out[551]:

```
Index(['Date', 'Location', 'Country', 'DamageLevel', 'TypeOfAircraft',
       'Manufacturer', 'Built', 'Engines', 'Passengers', 'Fatal-Injuries',
       'Serious-Injuries', 'Minor-Injuries', 'Uninjured', 'Weather-Condition',
       'Flight.Phase', 'Latitude', 'Longitude'],
      dtype='object')
```

In [552…

```
# Assuming your DataFrame is named df
df['Date'] = pd.to_datetime(df['Date'])
df['Year'] = df['Date'].dt.year
# confirming
df.columns
# rearranging columns again
columns = ['Date', 'Location', 'Country', 'DamageLevel', 'TypeOfAircraft',
'Manufacturer', 'Built', 'Engines', 'Passengers', 'Fatal-Injuries',
'Serious-Injuries', 'Minor-Injuries', 'Uninjured', 'Weather-Condition',
'Flight.Phase', 'Latitude', 'Longitude', 'Year']
# cementing
df = df[['Year', 'Date', 'Location', 'Country', 'DamageLevel', 'TypeOfAircraft',
'Manufacturer', 'Built', 'Engines', 'Passengers', 'Fatal-Injuries',
'Serious-Injuries', 'Minor-Injuries', 'Uninjured', 'Weather-Condition',
'Flight.Phase', 'Latitude', 'Longitude']]
```

```
# check
df.columns
```

Out[552]:
```
Index(['Year', 'Date', 'Location', 'Country', 'DamageLevel', 'TypeOfAircraft',
       'Manufacturer', 'Built', 'Engines', 'Passengers', 'Fatal-Injuries',
       'Serious-Injuries', 'Minor-Injuries', 'Uninjured', 'Weather-Condition',
       'Flight.Phase', 'Latitude', 'Longitude'],
      dtype='object')
```

In [553…
```
# Weather-Condition
df['Weather-Condition'].value_counts()

# corrections
weather_correction = {'UNK': 'Unknown',
'IMC': 'Bad',
'VMC': 'Good',
'Unk': 'Unknown'
}

df['Weather-Condition'] = df['Weather-Condition'].replace(weather_correction)
# cementing changes
df['Weather-Condition'].unique()
```

Out[553]:
```
array(['Unknown', 'Bad', 'Good'], dtype=object)
```

Exporting csv

In [576…
```
# exporting csv
filename = 'final-output.csv'

try:
    # Check if file exists and overwrite or create it
    if os.path.exists(filename):
        print(f"File '{filename}' previously existed but overwritten.", end='\n')
    else:
        df.to_csv(filename, index=False)
        print(f"The csv-file '{filename}' was not found, so it has been created.", enc

except PermissionError as e:
    print(f"PermissionError: Unable to write to '{filename}'. Please check file permis
    print(f"Error details: {e}", end='\n')

#   The End!
print('')
print('The End!')
```

```
File 'final-output.csv' previously existed but overwritten.

The End!
```

In [577…
```
df.columns
```

Out[577]:
```
Index(['Year', 'Date', 'Location', 'Country', 'DamageLevel', 'TypeOfAircraft',
       'Manufacturer', 'Built', 'Engines', 'Passengers', 'Fatal-Injuries',
       'Serious-Injuries', 'Minor-Injuries', 'Uninjured', 'Weather-Condition',
       'Flight.Phase', 'Latitude', 'Longitude'],
      dtype='object')
```

The Research Questions are:-

SPECIFIC OBJECTIVES

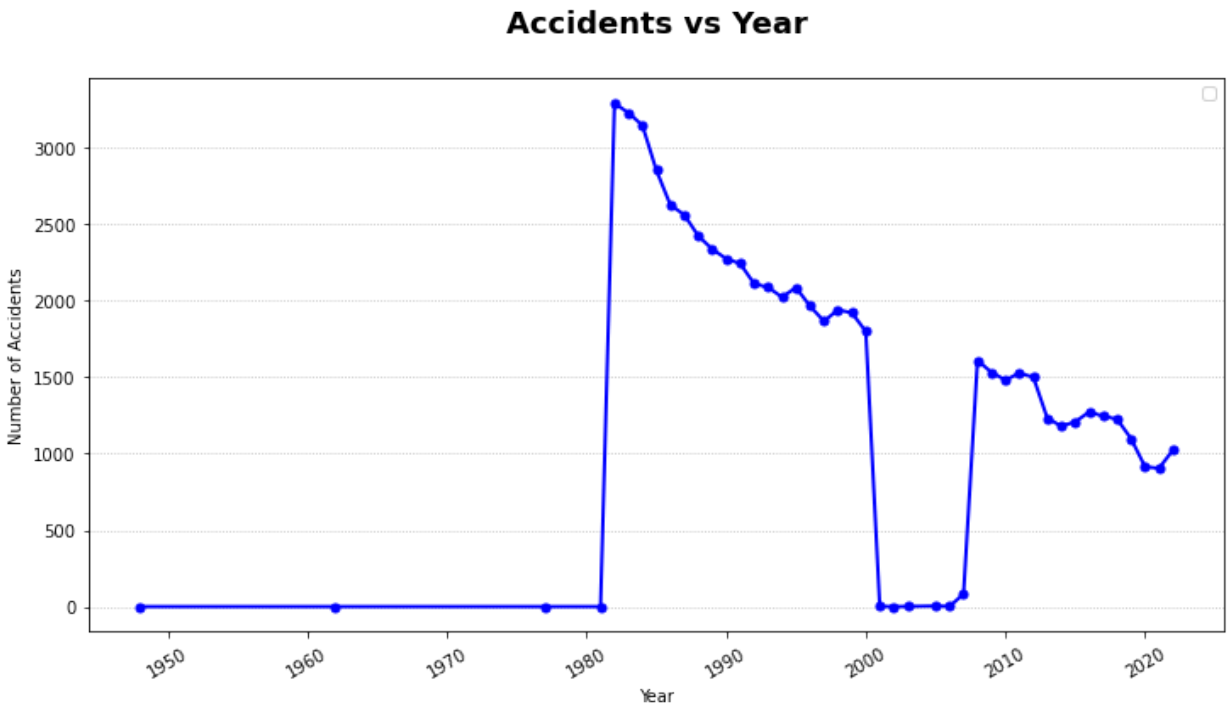
1. Analyse Aircraft Safety Records – Examine historical accident data to identify aircraft models with the lowest accident and fatality rates.
2. Evaluate Risk Factors by Aircraft Type – Assess how factors such as aircraft age, manufacturer, engine type, and passenger capacity influence accident frequency and severity.
3. Assess the Impact of Weather and Geographic Location – Determine how different weather conditions and regions contribute to aircraft accidents and identify aircraft best suited for various environments.

Line Graph Of Accident Vs Year

In [578…

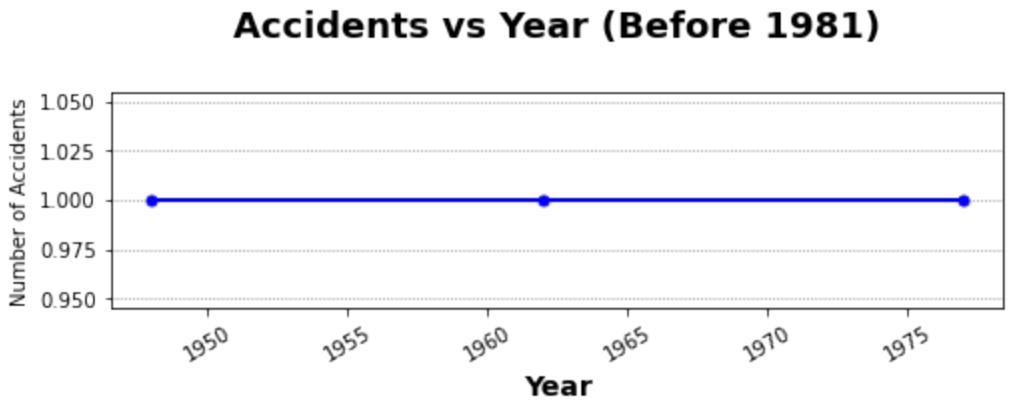
```
# Step 1: Group by 'Year' and count the accidents per year
accidents_per_year = df.groupby(df['Date'].dt.year).size()

# figure size
plt.figure(figsize=(12, 6))
# Step 2: Plot a line graph
plt.plot(accidents_per_year.index, accidents_per_year.values, marker='o', color='b', l
# Labels
plt.title('Accidents vs Year\n',
          fontsize = 18,
          fontweight = 'bold'
          )
plt.xlabel('Year')
plt.ylabel('Number of Accidents')
# Show
plt.xticks(rotation=30)
plt.grid(axis='y', linestyle=':', color='gray', alpha = 0.5)
plt.legend()
plt.show();
```

```
No handles with labels found to put in legend.
```



In [579…

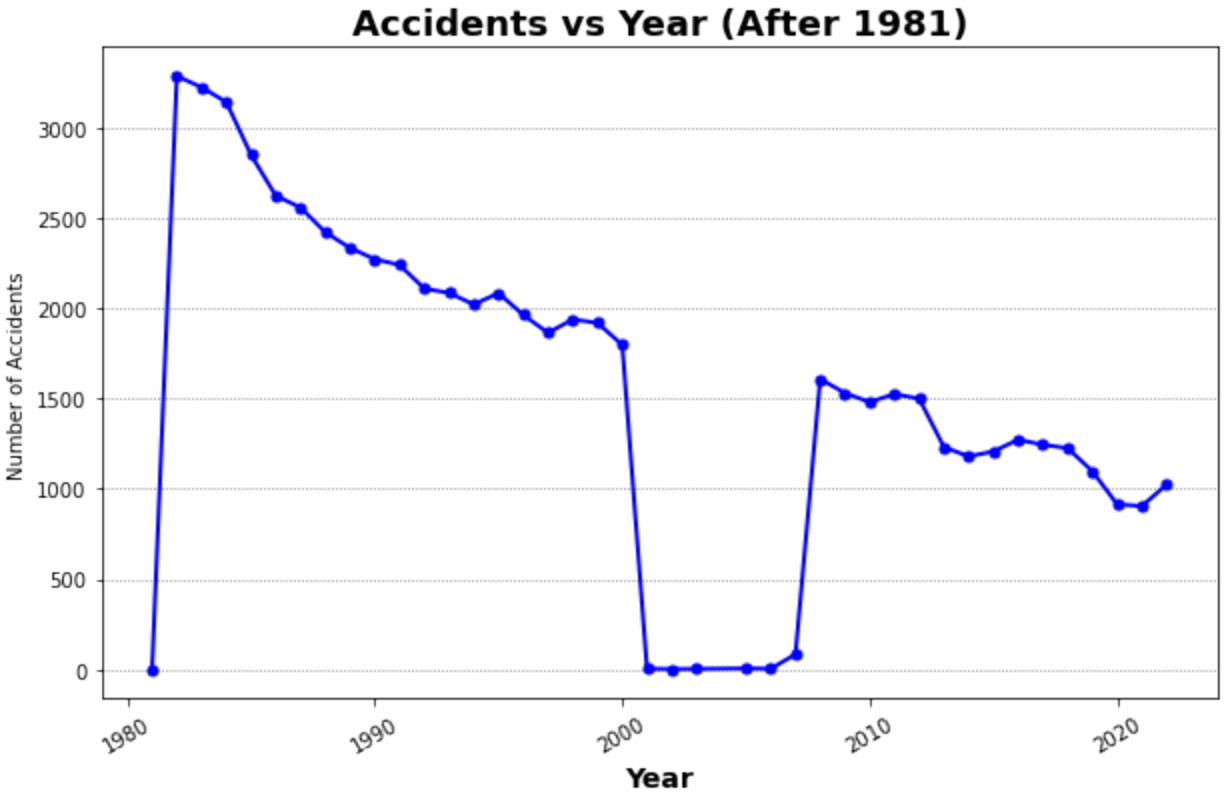
```
# Step 2: Filter for years before 1981
df_filter = df[df['Date'].dt.year < 1981]

# Step 3: Group by 'Year' and count the accidents per year
accidents_per_year = df_filter.groupby(df_filter['Date'].dt.year).size()

# Step 4: Plot a line graph
plt.figure(figsize=(8, 2))
plt.plot(accidents_per_year.index, accidents_per_year.values, marker='o', color='b', l
plt.title('Accidents vs Year (Before 1981)\n',
          fontsize = 18,
          fontweight = 'bold'
          )
plt.xlabel('Year', fontsize=14, fontweight='bold')  # Make x-axis label bigger and bol
plt.ylabel('Number of Accidents')

# Show only the y-axis grid with dotted lines
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
plt.xticks(rotation=30)
plt.show()
```



In [580…

```
# Step 2: Filter for years before 1981
df_filter = df[df['Date'].dt.year >= 1981]
```

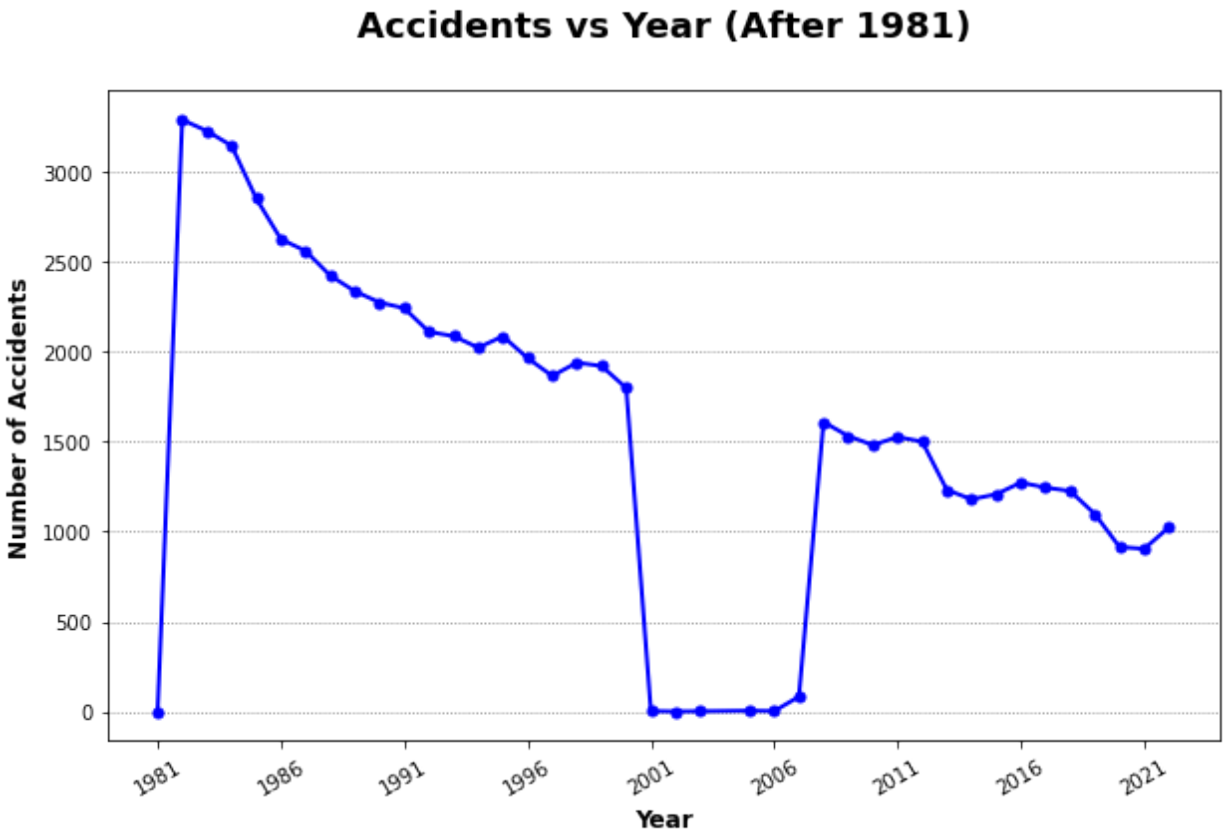
```
# Step 3: Group by 'Year' and count the accidents per year
accidents_per_year = df_filter.groupby(df_filter['Date'].dt.year).size()

# Step 4: Plot a line graph
plt.figure(figsize=(10, 6))
plt.plot(accidents_per_year.index, accidents_per_year.values, marker='o', color='b', l
plt.title('Accidents vs Year (After 1981)',
          fontsize = 18,
          fontweight = 'bold')
plt.xlabel('Year', fontsize=14, fontweight='bold')  # Make x-axis label bigger and bol
plt.ylabel('Number of Accidents')

# Show only the y-axis grid with dotted lines
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
plt.xticks(rotation=30)
plt.show()
```



In [581…

```
# Step 2: Filter for years before 1981
df_filter = df[df['Date'].dt.year >= 1981]

# Step 3: Group by 'Year' and count the accidents per year
accidents_per_year = df_filter.groupby(df_filter['Date'].dt.year).size()

# Step 4: Plot a line graph
plt.figure(figsize=(10, 6))
plt.plot(accidents_per_year.index, accidents_per_year.values, marker='o', color='b', l
plt.title('Accidents vs Year (After 1981)\n',
          fontsize = 18,
          fontweight = 'bold'
          )
plt.xlabel('Year',
          fontsize = 12,
          fontweight = 'bold'
```

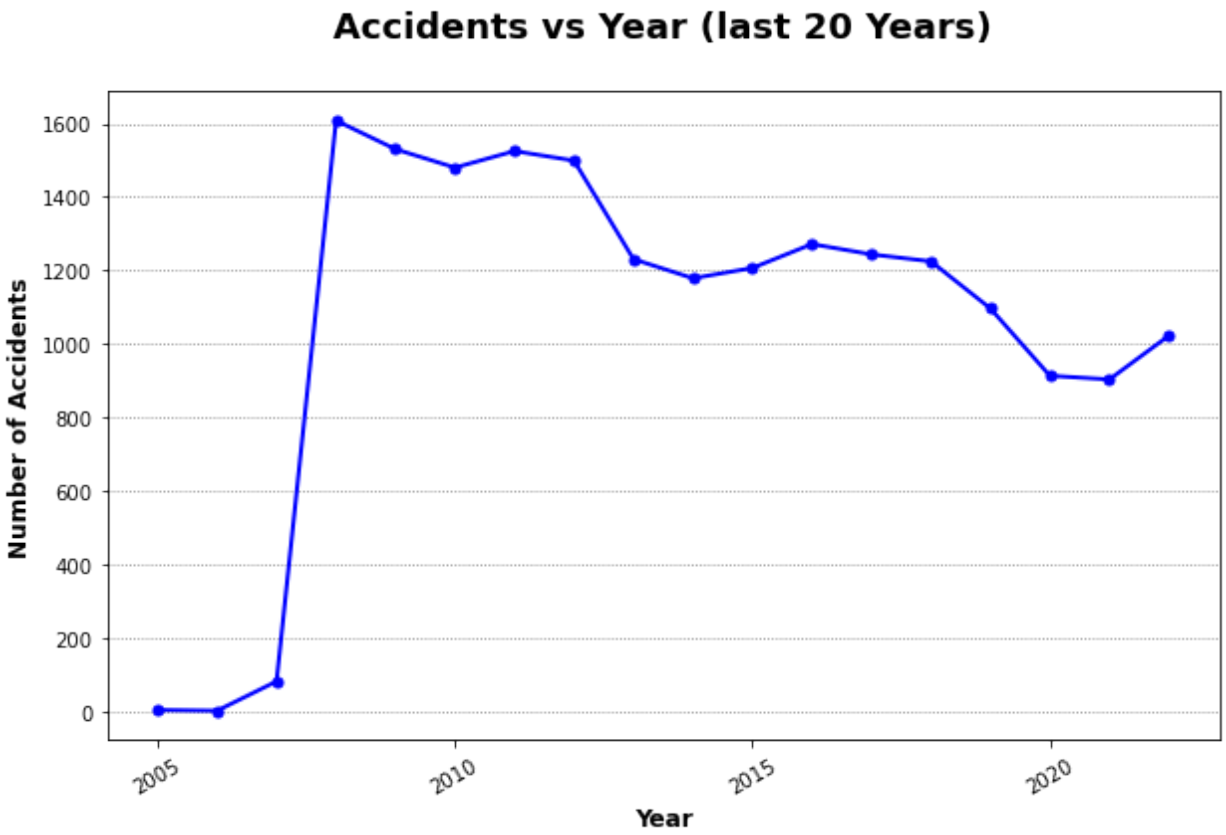
```
          )
plt.ylabel('Number of Accidents',
          fontsize = 12,
          fontweight = 'bold'
          )
# Show only the y-axis grid with dotted lines
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
# Set x-ticks every 5 years
plt.xticks(range(min(accidents_per_year.index), max(accidents_per_year.index) + 1, 5))
# rotation
plt.xticks(rotation=30)
plt.show();
```



In [582…

```
# Step 2: Filter for years before 1981
df_filter = df[df['Date'].dt.year >= 2005]

# Step 3: Group by 'Year' and count the accidents per year
accidents_per_year = df_filter.groupby(df_filter['Date'].dt.year).size()

# Step 4: Plot a line graph
plt.figure(figsize=(10, 6))
plt.plot(accidents_per_year.index, accidents_per_year.values,
         marker='o',
         color='b',
         linestyle='-',
         linewidth=2,
         markersize=5
         )
plt.title('Accidents vs Year (last 20 Years)\n',
          fontsize = 18,
          fontweight = 'bold'
          )
plt.xlabel('Year',
```

```
          fontsize = 12,
          fontweight = 'bold'
          )
plt.ylabel('Number of Accidents',
          fontsize = 12,
          fontweight = 'bold'
          )
# Show only the y-axis grid with dotted lines
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
# Set x-ticks every 5 years
plt.xticks(range(min(accidents_per_year.index), max(accidents_per_year.index) + 1, 5))
# rotation
plt.xticks(rotation=30)
plt.show();
```

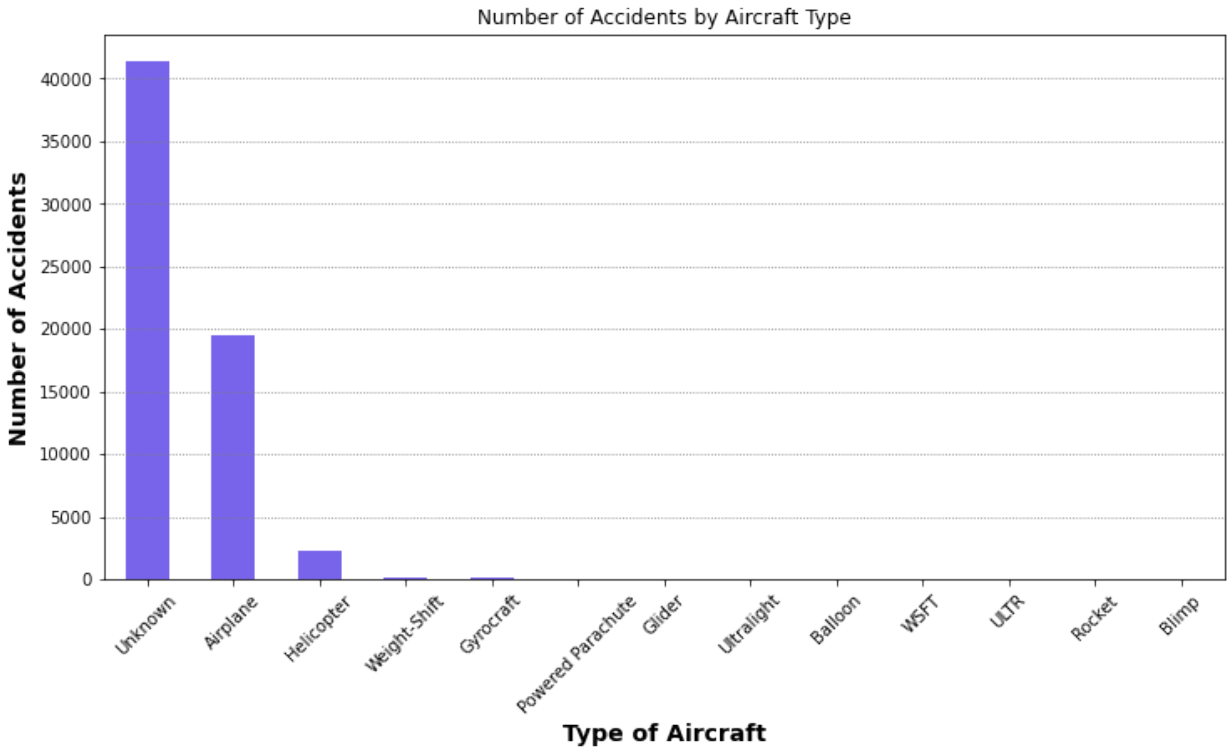


viz-1: TypeOfAircraft vs count the accidents

In [583…

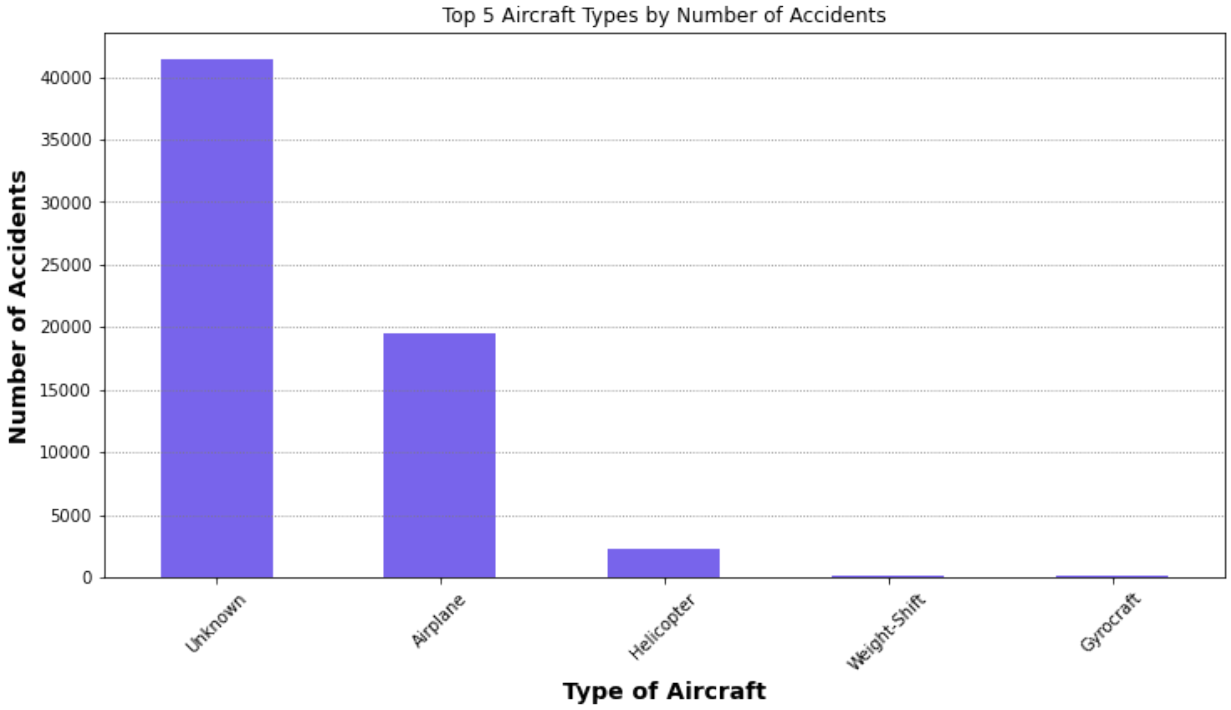
```
# Step 1: Group by 'TypeOfAircraft' and count the accidents
accidents_per_aircraft_type = df.groupby('TypeOfAircraft').size()

# Step 2: Plot a bar graph
plt.figure(figsize=(12, 6))
accidents_per_aircraft_type.sort_values(ascending=False).plot(kind='bar', color='mediu

# labels and title
plt.title('Number of Accidents by Aircraft Type')
plt.xlabel('Type of Aircraft', fontsize=14, fontweight='bold')  # Make x-axis label bi
plt.ylabel('Number of Accidents', fontsize=14, fontweight='bold')  # Make y-axis label

# Rotate x-axis labels to avoid overlap
plt.xticks(rotation=45)
```

```
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
plt.show();
```



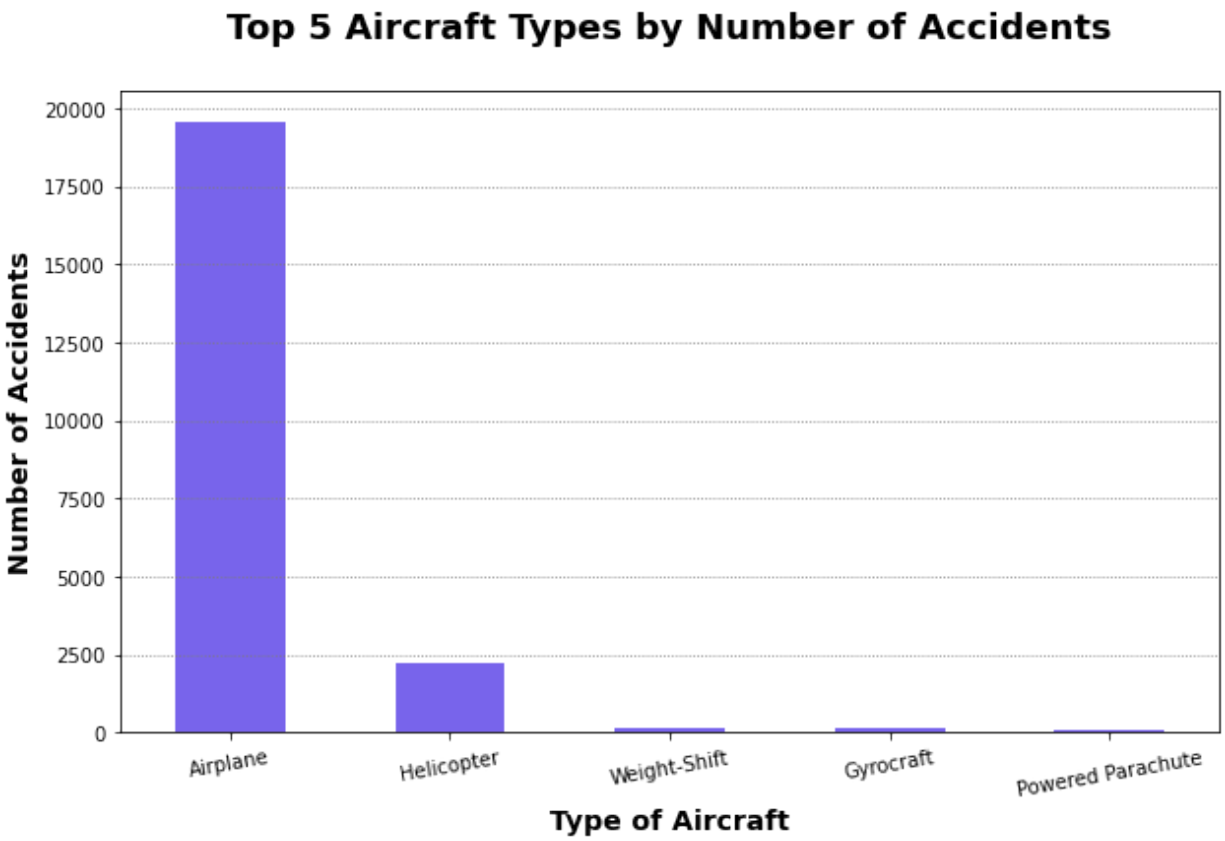
In [584…

```
# Step 1: Group by 'TypeOfAircraft' and count the accidents
accidents_per_aircraft_type = df.groupby('TypeOfAircraft').size()

# Step 2: Get the top 10 most frequent aircraft types
top_5_accidents = accidents_per_aircraft_type.sort_values(ascending=False).head(5)

# Step 3: Plot a bar graph
plt.figure(figsize=(12, 6))
# top 10
top_5_accidents.plot(kind='bar', color='mediumslateblue')

# labels and title
plt.title('Top 5 Aircraft Types by Number of Accidents')
plt.xlabel('Type of Aircraft', fontsize=14, fontweight='bold')
plt.ylabel('Number of Accidents', fontsize=14, fontweight='bold')

# Rotate x-axis labels to avoid overlap
plt.xticks(rotation=45)
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
plt.show()
```



In [606…

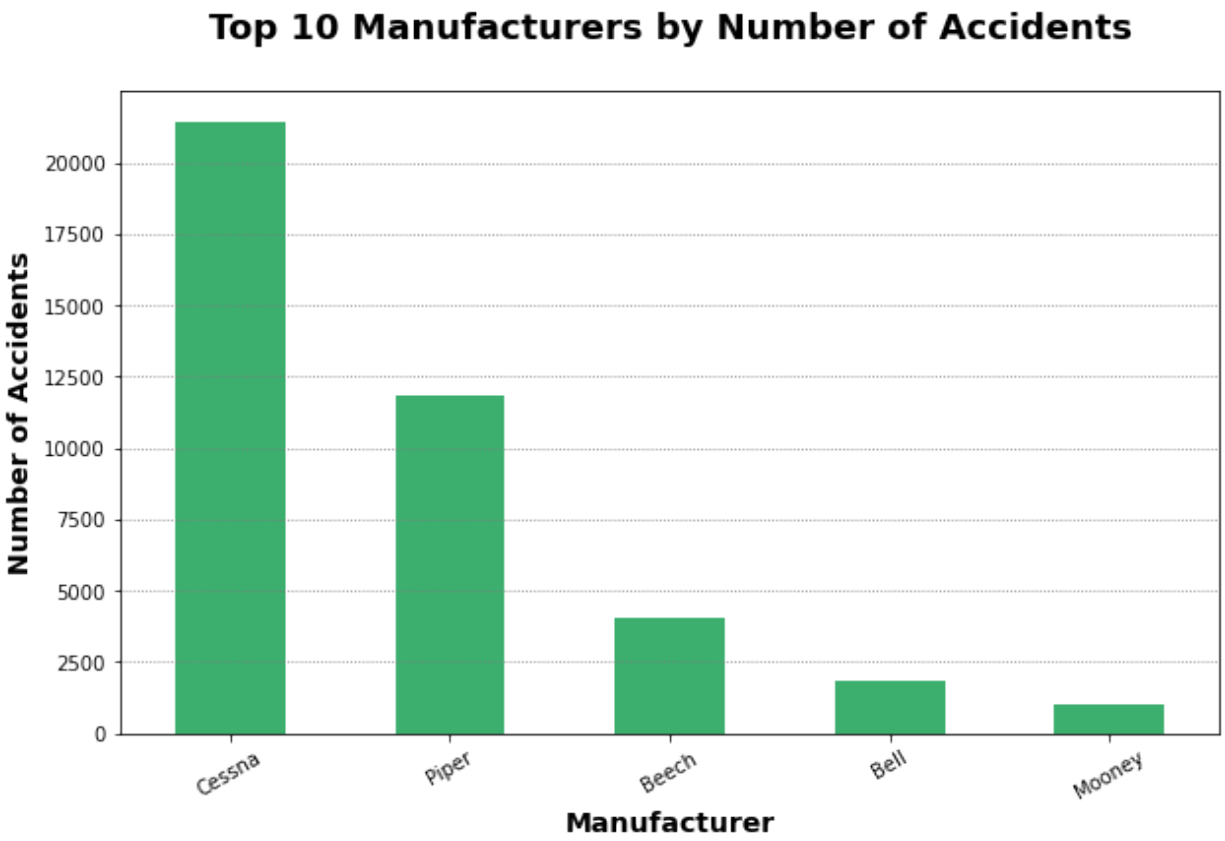
```
# Step 1: Filter out 'Unknown' values from 'TypeOfAircraft'
df_filtered = df[df['TypeOfAircraft'] != 'Unknown']

# Step 2: Group by 'TypeOfAircraft' and count the accidents
accidents_per_aircraft_type = df_filtered.groupby('TypeOfAircraft').size()

# Step 3: Get the top 5 most frequent aircraft types
top_5_accidents = accidents_per_aircraft_type.sort_values(ascending=False).head(5)

# Step 4: Plot a bar graph
plt.figure(figsize=(10, 6))
top_5_accidents.plot(kind='bar', color='mediumslateblue')

# Labels and title
plt.title('Top 5 Aircraft Types by Number of Accidents\n',
          fontsize=18,
          fontweight='bold'
          )
plt.xlabel('Type of Aircraft', fontsize=14, fontweight='bold')
plt.ylabel('Number of Accidents', fontsize=14, fontweight='bold')

# Rotate x-axis labels to avoid overlap
plt.xticks(rotation=10)
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
plt.show();
```



viz-2: Manufacturer vs count the accidents

In [586…

```
# Step 1: Group by 'Manufacturer' and count the accidents
accidents_per_manufacturer = df.groupby('Manufacturer').size()

# Step 2: Get the top manufacturers based on accident count (optional if needed)
top_manufacturers = accidents_per_manufacturer.sort_values(ascending=False).head(5)  #

# Step 3: Plot a bar graph
plt.figure(figsize=(10, 6))
top_manufacturers.plot(kind='bar', color='mediumseagreen')

# labels and title
plt.title('Top 10 Manufacturers by Number of Accidents\n',
          fontsize=18,
          fontweight='bold'
          )
plt.xlabel('Manufacturer', fontsize=14, fontweight='bold')
plt.ylabel('Number of Accidents', fontsize=14, fontweight='bold')

# Rotate x-axis labels to avoid overlap
plt.xticks(rotation=30)
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
plt.show()
```

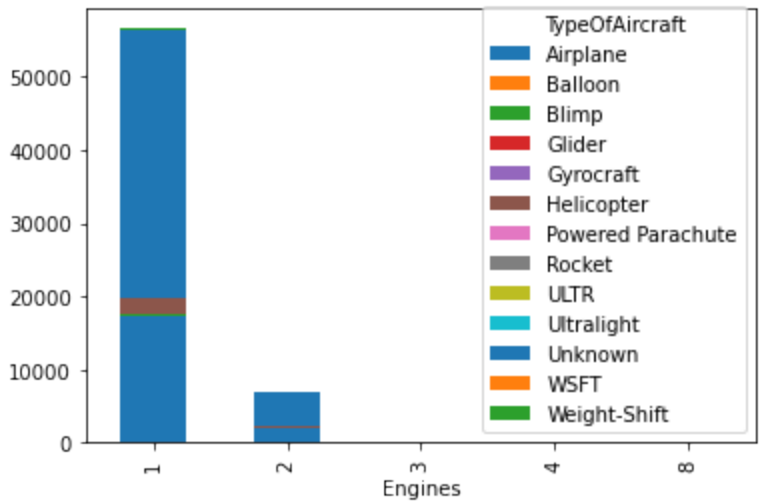


Objective 2:

Evaluate Risk Factors by Aircraft Type – Assess how factors such as aircraft age, manufacturer, engine type, and passenger capacity influence accident frequency and severity

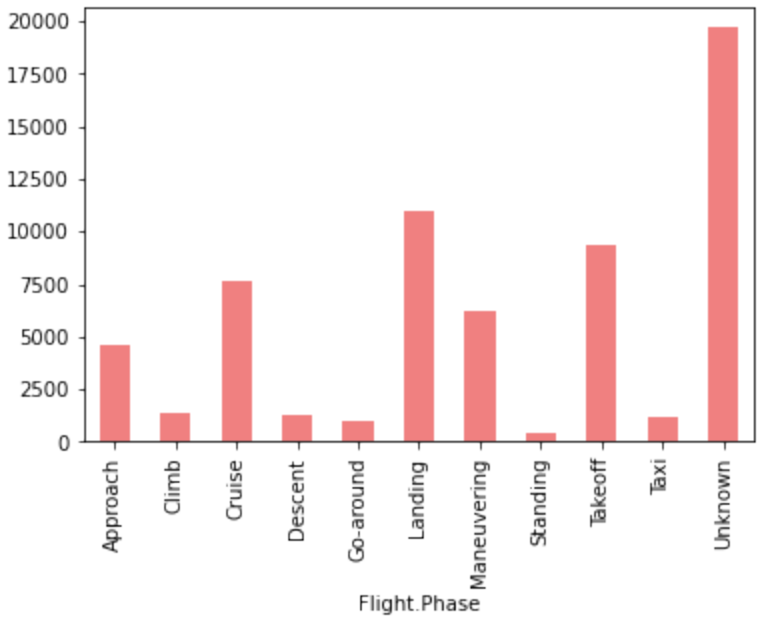
In [587…
```
accidents_by_engine = df.groupby(['Engines', 'TypeOfAircraft']).size().unstack()
accidents_by_engine.plot(kind='bar', stacked=True)
```

Out[587]:
```
<AxesSubplot:xlabel='Engines'>
```



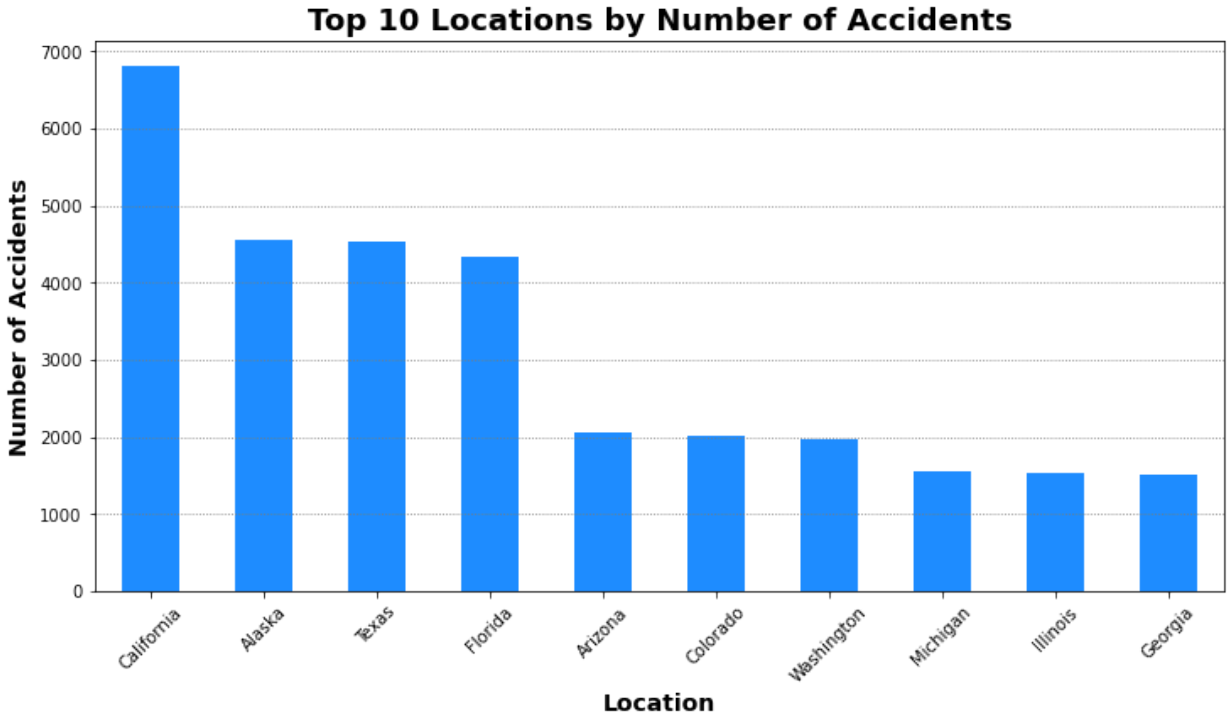
In [588…
```
accidents_by_phase = df.groupby('Flight.Phase').size()
accidents_by_phase.plot(kind='bar', color='lightcoral')
```

Out[588]: <AxesSubplot:xlabel='Flight.Phase'>



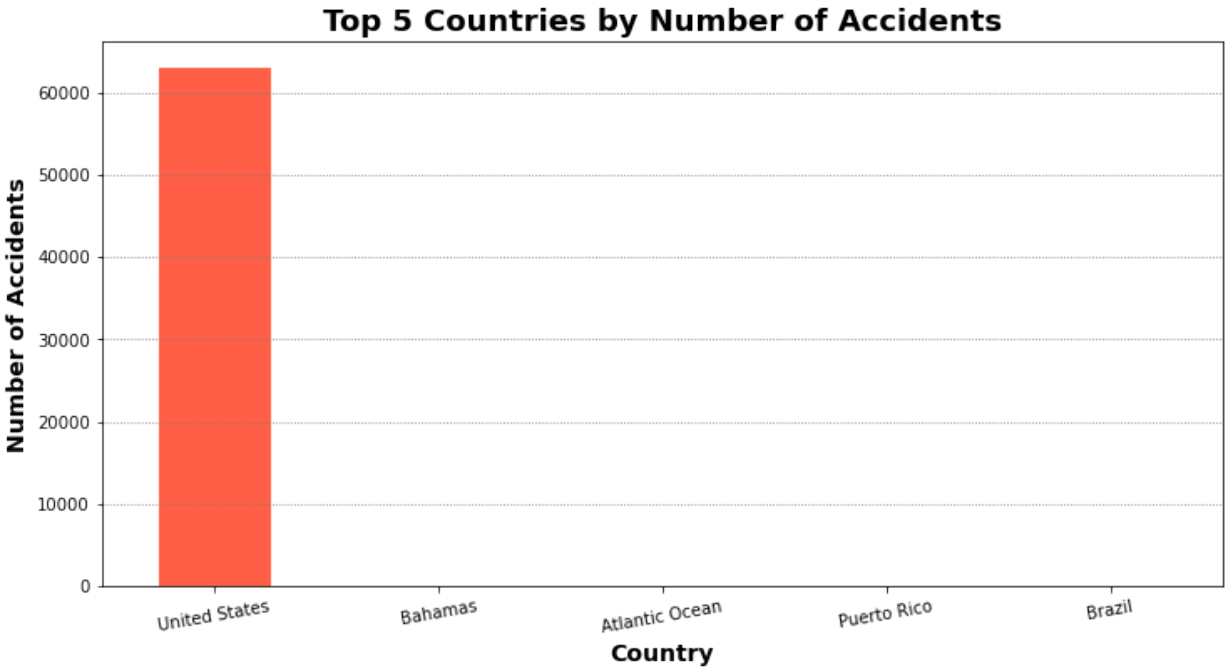
In [602…

```
# Location against Count
# # Step 1: Group by 'Location' and count the accidents
accidents_per_location = df.groupby('Location').size()

# Step 2: Get the top 10 locations based on accident count (optional for better visual
top_10_locations = accidents_per_location.sort_values(ascending=False).head(10)

# Step 3: Plot a bar graph
plt.figure(figsize=(12, 6))
top_10_locations.plot(kind='bar', color='dodgerblue')

# labels and title
plt.title('Top 10 Locations by Number of Accidents', fontsize=18, fontweight='bold')
plt.xlabel('Location', fontsize=14, fontweight='bold')
plt.ylabel('Number of Accidents', fontsize=14, fontweight='bold')

# Rotate x-axis labels to avoid overlap
plt.xticks(rotation=45)
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
plt.show();
```



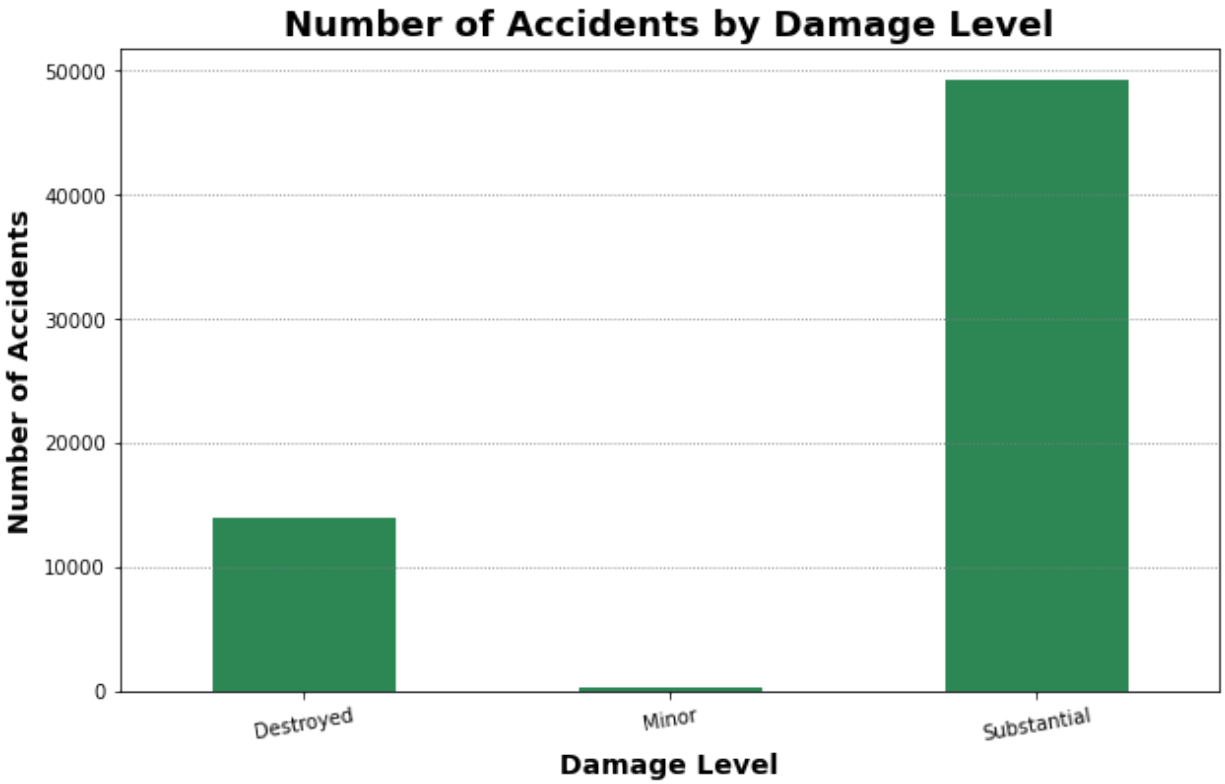
In [608…

```
# country vs count
# Step 1: Group by 'Country' and count the accidents
accidents_per_country = df.groupby('Country').size()

# Step 2: Get the top 10 countries based on accident count (optional for better visual
top_5_countries = accidents_per_country.sort_values(ascending=False).head(5)

# Step 3: Plot a bar graph
plt.figure(figsize=(12, 6))
top_5_countries.plot(kind='bar', color='tomato')

# Labels and title
plt.title('Top 5 Countries by Number of Accidents', fontsize=18, fontweight='bold')
plt.xlabel('Country', fontsize=14, fontweight='bold')  # Make x-axis label bigger and
plt.ylabel('Number of Accidents', fontsize=14, fontweight='bold')  # Make y-axis label

# Rotate x-axis labels to avoid overlap
plt.xticks(rotation=10)
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
plt.show()
```



In [609…

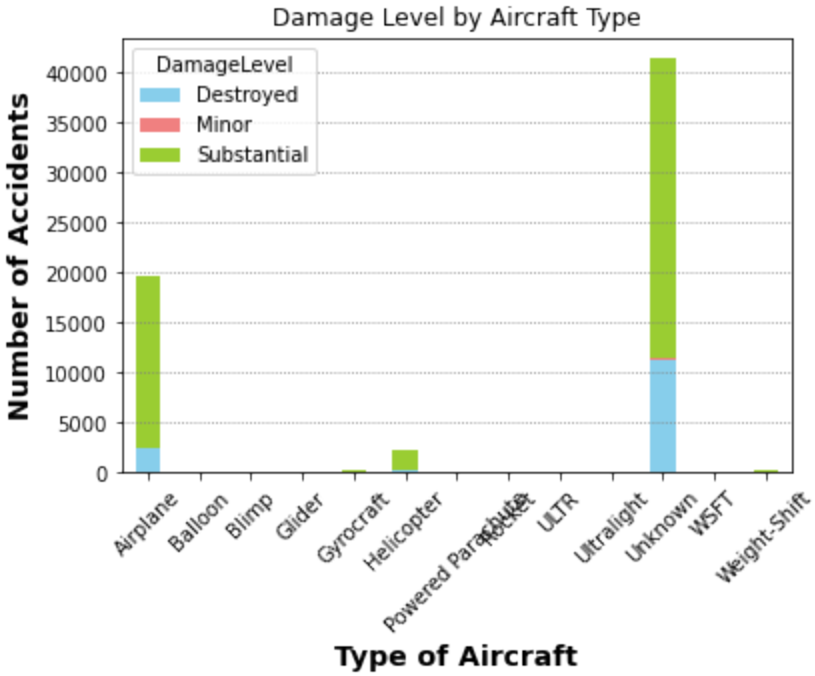
```
# damage level agansr count
# Step 1: Group by 'DamageLevel' and count the accidents
accidents_per_damage_level = df.groupby('DamageLevel').size()

# Step 2: Plot a bar graph
plt.figure(figsize=(10, 6))
accidents_per_damage_level.plot(kind='bar', color='seagreen')

# labels and title
plt.title('Number of Accidents by Damage Level', fontsize=18, fontweight='bold')
plt.xlabel('Damage Level', fontsize=14, fontweight='bold')  # Make x-axis label bigger
plt.ylabel('Number of Accidents', fontsize=14, fontweight='bold')  # Make y-axis label

# Rotate x-axis labels to avoid overlap if necessary
plt.xticks(rotation=10)
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
plt.show()
```



In [592…

```
# damagelevel against typeofAircft# Step 1: Group by 'DamageLevel' and 'TypeOfAircraft
damage_level_by_aircraft = df.groupby(['TypeOfAircraft', 'DamageLevel']).size().unstac

# Step 2: Plot a stacked bar chart
plt.figure(figsize=(12, 6))
damage_level_by_aircraft.plot(kind='bar', stacked=True, color=['skyblue', 'lightcoral'

# labels and title
plt.title('Damage Level by Aircraft Type')
plt.xlabel('Type of Aircraft', fontsize=14, fontweight='bold')  # Make x-axis label bi
plt.ylabel('Number of Accidents', fontsize=14, fontweight='bold')  # Make y-axis label

# Rotate x-axis labels to avoid overlap
plt.xticks(rotation=45)
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
plt.show()
```

```
<Figure size 864x432 with 0 Axes>
```

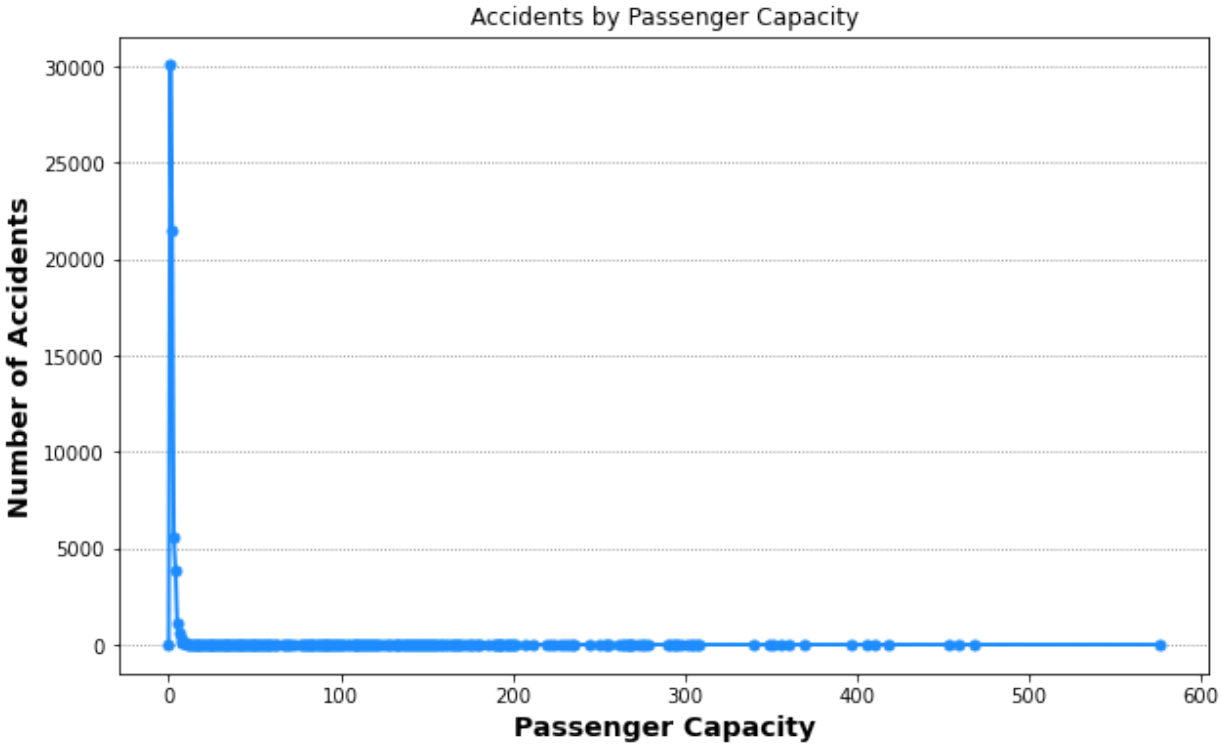


In [593…

```
# # Damagelevel against Manufacturer
# ---------------------------
# Takes longs to run
# ---------------------------
# # Step 1: Group by 'DamageLevel' and 'Manufacturer' and count the accidents
# damage_level_by_manufacturer = df.groupby(['Manufacturer', 'DamageLevel']).size().un

# # Step 2: Plot a stacked bar chart
# plt.figure(figsize=(12, 6))
# damage_level_by_manufacturer.plot(kind='bar', stacked=True, color=['skyblue', 'light

# # labels and title
# plt.title('Damage Level by Manufacturer')
# plt.xlabel('Manufacturer', fontsize=14, fontweight='bold')  # Make x-axis label bigg
# plt.ylabel('Number of Accidents', fontsize=14, fontweight='bold')  # Make y-axis lab

# # Rotate x-axis labels to avoid overlap
# plt.xticks(rotation=45)
# plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
# plt.show()
```

In [596…

```
# passenger against number of accidents
# Step 1: Group by 'Passengers' and count the accidents
accidents_by_passenger_capacity = df.groupby('Passengers').size()

# Step 2: Plot a line or scatter plot
plt.figure(figsize=(10, 6))
plt.plot(accidents_by_passenger_capacity.index, accidents_by_passenger_capacity.values

# labels and title
plt.title('Accidents by Passenger Capacity')
plt.xlabel('Passenger Capacity', fontsize=14, fontweight='bold')  # Make x-axis label
plt.ylabel('Number of Accidents', fontsize=14, fontweight='bold')  # Make y-axis label

# Show only the y-axis grid with dotted lines
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
plt.show()
```

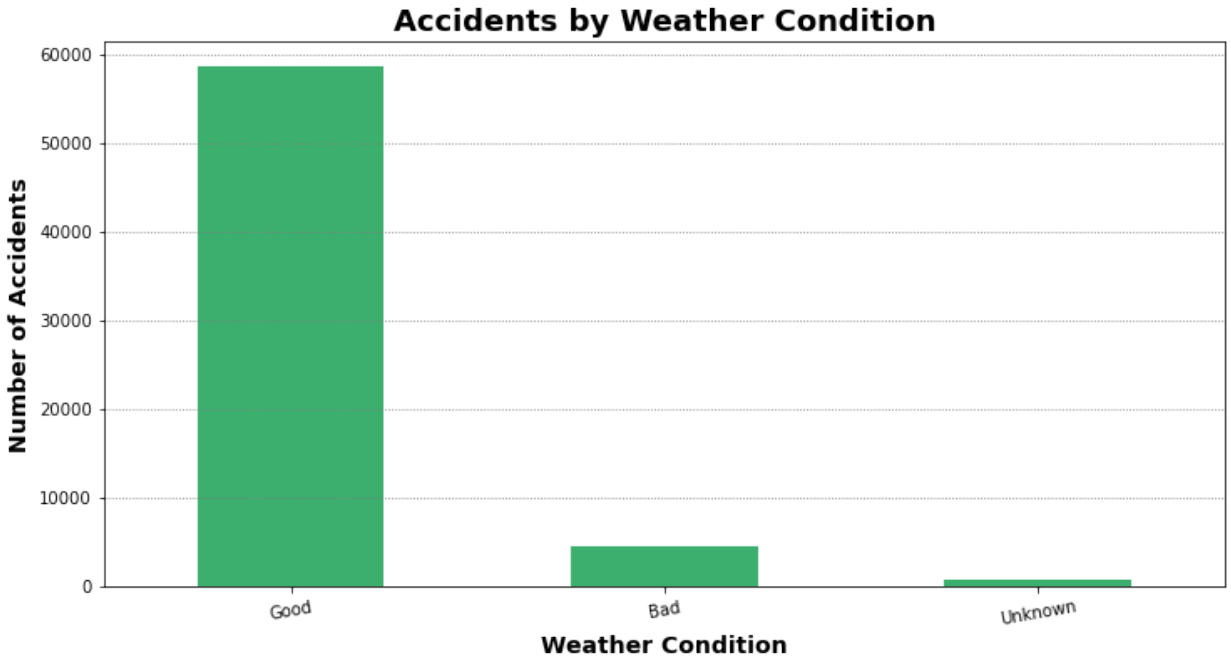


Objective 3:

Assess the Impact of Weather and Geographic Location – Determine how different weather conditions and regions contribute to aircraft accidents and identify aircraft best suited for various environments.

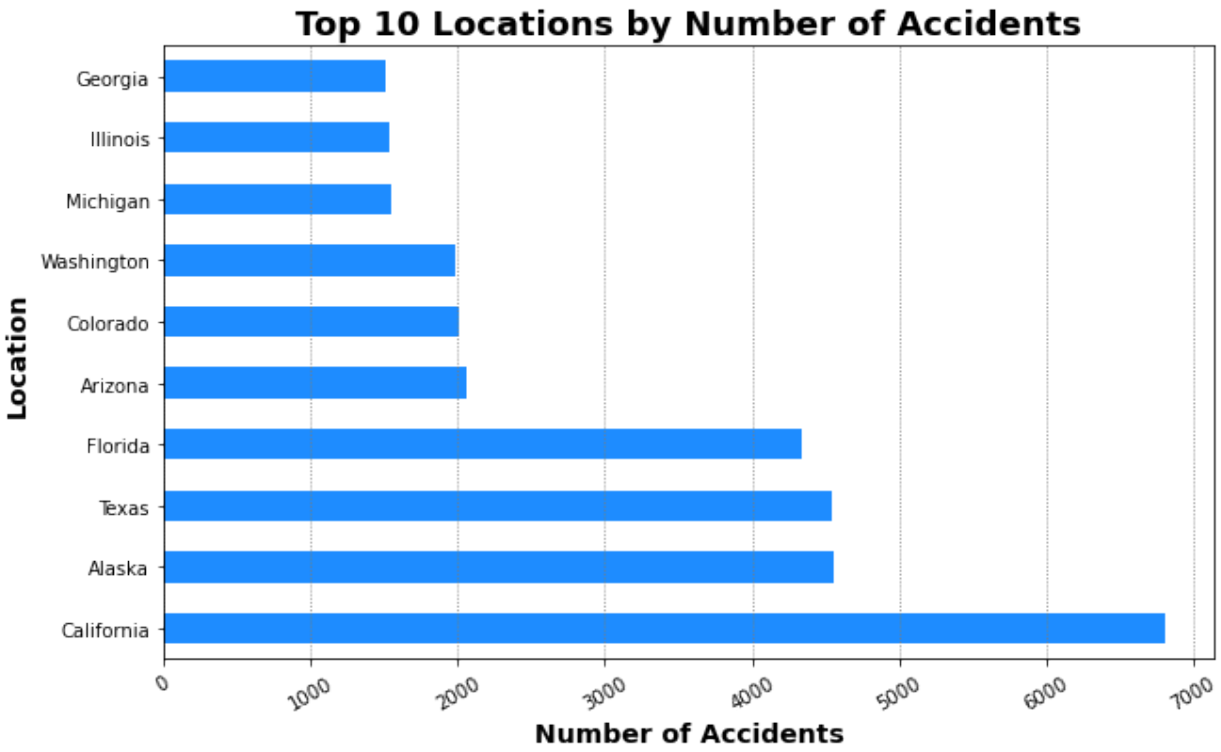
In [610…

```
# weather against count of accident
# Step 1: Group by 'Weather-Condition' and count the accidents
accidents_per_weather_condition = df.groupby('Weather-Condition').size()

# Step 2: Plot a bar chart
plt.figure(figsize=(12, 6))
accidents_per_weather_condition.sort_values(ascending=False).plot(kind='bar', color='m

# labels and title
plt.title('Accidents by Weather Condition', fontsize=18, fontweight='bold')
plt.xlabel('Weather Condition', fontsize=14, fontweight='bold')  # Make x-axis label b
plt.ylabel('Number of Accidents', fontsize=14, fontweight='bold')  # Make y-axis label

# Rotate x-axis labels to avoid overlap
plt.xticks(rotation=10)
plt.grid(axis='y', linestyle=':', color='gray')  # Dotted grid for y-axis
plt.show()
```



In [604…

```
# Location against count of accident
# Step 1: Group by 'Location' and count the accidents
accidents_per_location = df.groupby('Location').size()

# Step 2: Sort and get the top locations (optional to make the plot more readable)
top_locations = accidents_per_location.sort_values(ascending=False).head(10)

# Step 3: Plot a horizontal bar chart
plt.figure(figsize=(10, 6))
top_locations.plot(kind='barh', color='dodgerblue')

# Labels and title
plt.title('Top 10 Locations by Number of Accidents', fontsize=18, fontweight='bold')
plt.xlabel('Number of Accidents', fontsize=14, fontweight='bold')  # Make x-axis label
plt.ylabel('Location', fontsize=14, fontweight='bold')  # Make y-axis label bigger and

# Grid for better readability
plt.grid(axis='x', linestyle=':', color='gray')  # Dotted grid for x-axis
plt.xticks(rotation=30)
plt.show()
```


Top 10 Locations by Number of Accidents
Location
Georgia
Illinois
Michigan
Washington
Colorado
Arizona
Florida
Texas
Alaska
California
0
1000
2000
3000
4000
5000
6000
7000
Number of Accidents

In [ ]:

In [ ]: