```
import pandas as pd
aviation_df = pd.read_csv("AviationData.csv", encoding="ISO-8859-1",
low_memory=False)
state_df = pd.read_csv("USState_Codes.csv", encoding="ISO-8859-1")

aviation_df.head()
```

```
         Event.Id Investigation.Type Accident.Number  Event.Date  \
0  20001218X45444           Accident      SEA87LA080  1948-10-24
1  20001218X45447           Accident      LAX94LA336  1962-07-19
2  20061025X01555           Accident      NYC07LA005  1974-08-30
3  20001218X45448           Accident      LAX96LA321  1977-06-19
4  20041105X01764           Accident      CHI79FA064  1979-08-02

          Location        Country   Latitude   Longitude Airport.Code
\
0  MOOSE CREEK, ID  United States        NaN         NaN           NaN

1   BRIDGEPORT, CA  United States        NaN         NaN           NaN

2    Saltville, VA  United States  36.922223  -81.878056           NaN

3       EUREKA, CA  United States        NaN         NaN           NaN

4       Canton, OH  United States        NaN         NaN           NaN


  Airport.Name  ... Purpose.of.flight Air.carrier Total.Fatal.Injuries
\
0          NaN  ...          Personal         NaN                  2.0

1          NaN  ...          Personal         NaN                  4.0

2          NaN  ...          Personal         NaN                  3.0

3          NaN  ...          Personal         NaN                  2.0

4          NaN  ...          Personal         NaN                  1.0


  Total.Serious.Injuries Total.Minor.Injuries Total.Uninjured  \
0                    0.0                  0.0             0.0
1                    0.0                  0.0             0.0
2                    NaN                  NaN             NaN
3                    0.0                  0.0             0.0
4                    2.0                  NaN             0.0

  Weather.Condition  Broad.phase.of.flight   Report.Status
Publication.Date
```

```
0                UNK                   Cruise  Probable Cause
NaN
1                UNK                  Unknown  Probable Cause       19-
09-1996
2                IMC                   Cruise  Probable Cause       26-
02-2007
3                IMC                   Cruise  Probable Cause       12-
09-2000
4                VMC                 Approach  Probable Cause       16-
04-1980

[5 rows x 31 columns]
```

```
#summary of dataset structure
aviation_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
```

```
#number of missing values in each column
aviation_df.isnull().sum().sort_values(ascending=False)
```

```
Schedule                  76307
Air.carrier               72241
FAR.Description           56866
Aircraft.Category         56602
Longitude                 54516
Latitude                  54507
Airport.Code              38757
Airport.Name              36185
Broad.phase.of.flight     27165
Publication.Date          13771
Total.Serious.Injuries    12510
Total.Minor.Injuries      11933
Total.Fatal.Injuries      11401
Engine.Type                7096
Report.Status              6384
Purpose.of.flight          6192
Number.of.Engines          6084
Total.Uninjured            5912
Weather.Condition          4492
Aircraft.damage            3194
Registration.Number        1382
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
dtype: int64
```

```
#show column names
aviation_df.columns.tolist()
```

```
['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']

#drop columns mostly empty or not useful
aviation_df = aviation_df.drop(columns=['Publication.Date',
'Investigation.Type', 'Airport.Code'], errors='ignore')
print(aviation_df.head())

         Event.Id Accident.Number  Event.Date         Location
Country  \
0  20001218X45444      SEA87LA080  1948-10-24  MOOSE CREEK, ID  United
States
1  20001218X45447      LAX94LA336  1962-07-19   BRIDGEPORT, CA  United
States
2  20061025X01555      NYC07LA005  1974-08-30    Saltville, VA  United
States
3  20001218X45448      LAX96LA321  1977-06-19       EUREKA, CA  United
States
4  20041105X01764      CHI79FA064  1979-08-02       Canton, OH  United
States

    Latitude   Longitude Airport.Name Injury.Severity Aircraft.damage
...  \
0        NaN         NaN          NaN        Fatal(2)       Destroyed
...
1        NaN         NaN          NaN        Fatal(4)       Destroyed
...
```

```
2  36.922223  -81.878056          NaN        Fatal(3)       Destroyed
...
3        NaN         NaN          NaN        Fatal(2)       Destroyed
...
4        NaN         NaN          NaN        Fatal(1)       Destroyed
...

  Schedule Purpose.of.flight Air.carrier Total.Fatal.Injuries  \
0      NaN          Personal         NaN                  2.0
1      NaN          Personal         NaN                  4.0
2      NaN          Personal         NaN                  3.0
3      NaN          Personal         NaN                  2.0
4      NaN          Personal         NaN                  1.0

  Total.Serious.Injuries  Total.Minor.Injuries Total.Uninjured  \
0                    0.0                   0.0             0.0
1                    0.0                   0.0             0.0
2                    NaN                   NaN             NaN
3                    0.0                   0.0             0.0
4                    2.0                   NaN             0.0

  Weather.Condition Broad.phase.of.flight   Report.Status
0               UNK                Cruise  Probable Cause
1               UNK               Unknown  Probable Cause
2               IMC                Cruise  Probable Cause
3               IMC                Cruise  Probable Cause
4               VMC              Approach  Probable Cause

[5 rows x 28 columns]
```

```
#convert the Event.Date column to datetime
aviation_df['Event.Date'] =
pd.to_datetime(aviation_df['Event.Date'],errors='coerce')
aviation_df.head()
```

```
         Event.Id Accident.Number Event.Date         Location
Country  \
0  20001218X45444      SEA87LA080 1948-10-24  MOOSE CREEK, ID  United
States
1  20001218X45447      LAX94LA336 1962-07-19   BRIDGEPORT, CA  United
States
2  20061025X01555      NYC07LA005 1974-08-30    Saltville, VA  United
States
3  20001218X45448      LAX96LA321 1977-06-19       EUREKA, CA  United
States
4  20041105X01764      CHI79FA064 1979-08-02       Canton, OH  United
States

    Latitude   Longitude Airport.Name Injury.Severity Aircraft.damage
...  \
```

```
0        NaN         NaN           NaN        Fatal(2)       Destroyed
...
1        NaN         NaN           NaN        Fatal(4)       Destroyed
...
2  36.922223  -81.878056           NaN        Fatal(3)       Destroyed
...
3        NaN         NaN           NaN        Fatal(2)       Destroyed
...
4        NaN         NaN           NaN        Fatal(1)       Destroyed
...

  Schedule Purpose.of.flight Air.carrier Total.Fatal.Injuries  \
0      NaN          Personal         NaN                  2.0
1      NaN          Personal         NaN                  4.0
2      NaN          Personal         NaN                  3.0
3      NaN          Personal         NaN                  2.0
4      NaN          Personal         NaN                  1.0

  Total.Serious.Injuries  Total.Minor.Injuries Total.Uninjured  \
0                    0.0                   0.0             0.0
1                    0.0                   0.0             0.0
2                    NaN                   NaN             NaN
3                    0.0                   0.0             0.0
4                    2.0                   NaN             0.0

  Weather.Condition Broad.phase.of.flight   Report.Status
0               UNK                Cruise  Probable Cause
1               UNK               Unknown  Probable Cause
2               IMC                Cruise  Probable Cause
3               IMC                Cruise  Probable Cause
4               VMC              Approach  Probable Cause

[5 rows x 28 columns]
```

```
#drop rows where Event.Date is missing
aviation_df = aviation_df.dropna(subset=['Event.Date'])
aviation_df.head()
```

```
         Event.Id Accident.Number  Event.Date         Location
Country  \
0  20001218X45444      SEA87LA080  1948-10-24  MOOSE CREEK, ID  United
States
1  20001218X45447      LAX94LA336  1962-07-19   BRIDGEPORT, CA  United
States
2  20061025X01555      NYC07LA005  1974-08-30    Saltville, VA  United
States
3  20001218X45448      LAX96LA321  1977-06-19       EUREKA, CA  United
States
4  20041105X01764      CHI79FA064  1979-08-02       Canton, OH  United
States
```

```
    Latitude   Longitude Airport.Name Injury.Severity Aircraft.damage
...  \
0        NaN         NaN          NaN        Fatal(2)       Destroyed
...
1        NaN         NaN          NaN        Fatal(4)       Destroyed
...
2  36.922223  -81.878056          NaN        Fatal(3)       Destroyed
...
3        NaN         NaN          NaN        Fatal(2)       Destroyed
...
4        NaN         NaN          NaN        Fatal(1)       Destroyed
...

  Schedule Purpose.of.flight Air.carrier Total.Fatal.Injuries  \
0      NaN          Personal         NaN                  2.0
1      NaN          Personal         NaN                  4.0
2      NaN          Personal         NaN                  3.0
3      NaN          Personal         NaN                  2.0
4      NaN          Personal         NaN                  1.0

  Total.Serious.Injuries  Total.Minor.Injuries Total.Uninjured  \
0                    0.0                   0.0             0.0
1                    0.0                   0.0             0.0
2                    NaN                   NaN             NaN
3                    0.0                   0.0             0.0
4                    2.0                   NaN             0.0

  Weather.Condition Broad.phase.of.flight   Report.Status
0               UNK                Cruise  Probable Cause
1               UNK               Unknown  Probable Cause
2               IMC                Cruise  Probable Cause
3               IMC                Cruise  Probable Cause
4               VMC              Approach  Probable Cause

[5 rows x 28 columns]
```

```
#fill other missing values
aviation_df['Weather.Condition']=
aviation_df['Weather.Condition'].fillna('Unknown')
aviation_df.head()
```

```
         Event.Id Accident.Number  Event.Date         Location
Country  \
0  20001218X45444      SEA87LA080  1948-10-24  MOOSE CREEK, ID  United
States
1  20001218X45447      LAX94LA336  1962-07-19   BRIDGEPORT, CA  United
States
2  20061025X01555      NYC07LA005  1974-08-30    Saltville, VA  United
States
```

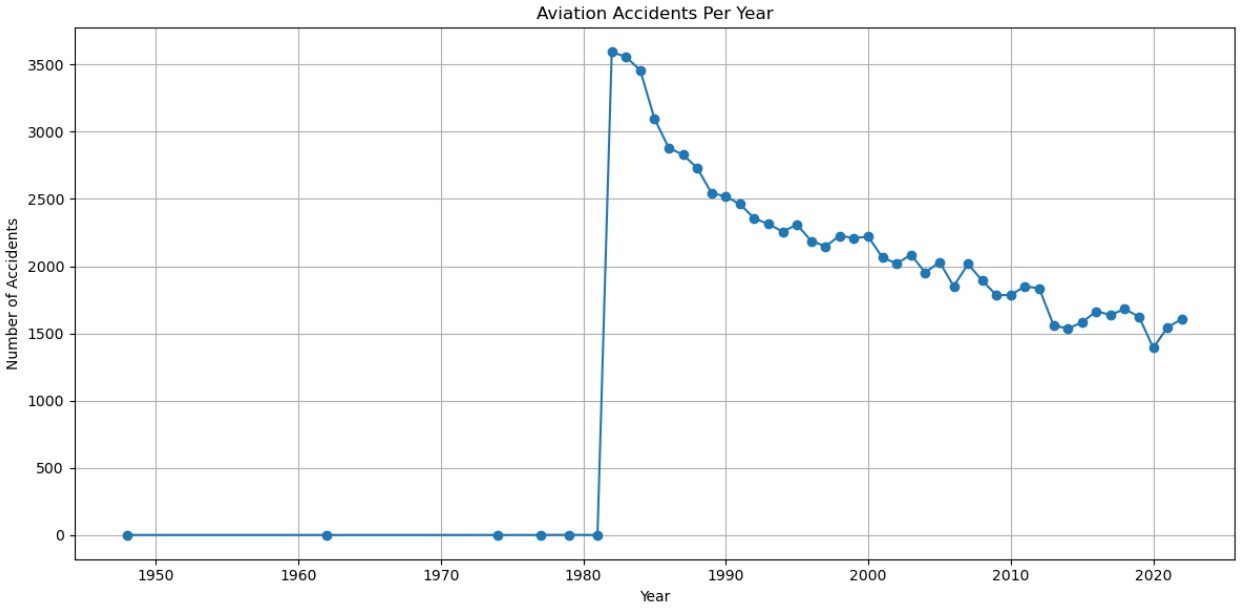
```
3  20001218X45448      LAX96LA321  1977-06-19       EUREKA, CA  United
States
4  20041105X01764      CHI79FA064  1979-08-02       Canton, OH  United
States

    Latitude   Longitude Airport.Name Injury.Severity Aircraft.damage
...  \
0        NaN         NaN          NaN        Fatal(2)       Destroyed
...
1        NaN         NaN          NaN        Fatal(4)       Destroyed
...
2  36.922223  -81.878056          NaN        Fatal(3)       Destroyed
...
3        NaN         NaN          NaN        Fatal(2)       Destroyed
...
4        NaN         NaN          NaN        Fatal(1)       Destroyed
...

  Schedule Purpose.of.flight Air.carrier Total.Fatal.Injuries  \
0      NaN          Personal         NaN                  2.0
1      NaN          Personal         NaN                  4.0
2      NaN          Personal         NaN                  3.0
3      NaN          Personal         NaN                  2.0
4      NaN          Personal         NaN                  1.0

  Total.Serious.Injuries  Total.Minor.Injuries Total.Uninjured  \
0                    0.0                   0.0             0.0
1                    0.0                   0.0             0.0
2                    NaN                   NaN             NaN
3                    0.0                   0.0             0.0
4                    2.0                   NaN             0.0

  Weather.Condition Broad.phase.of.flight   Report.Status
0               UNK                Cruise  Probable Cause
1               UNK               Unknown  Probable Cause
2               IMC                Cruise  Probable Cause
3               IMC                Cruise  Probable Cause
4               VMC              Approach  Probable Cause

[5 rows x 28 columns]

aviation_df.info

<bound method DataFrame.info of              Event.Id Accident.Number
Event.Date         Location  \
0      20001218X45444      SEA87LA080  1948-10-24  MOOSE CREEK, ID
1      20001218X45447      LAX94LA336  1962-07-19   BRIDGEPORT, CA
2      20061025X01555      NYC07LA005  1974-08-30    Saltville, VA
3      20001218X45448      LAX96LA321  1977-06-19       EUREKA, CA
4      20041105X01764      CHI79FA064  1979-08-02       Canton, OH
```

```
...                ...              ...         ...               ...
88884  20221227106491      ERA23LA093  2022-12-26    Annapolis, MD
88885  20221227106494      ERA23LA095  2022-12-26      Hampton, NH
88886  20221227106497      WPR23LA075  2022-12-26       Payson, AZ
88887  20221227106498      WPR23LA076  2022-12-26       Morgan, UT
88888  20221230106513      ERA23LA097  2022-12-29       Athens, GA

             Country   Latitude   Longitude Airport.Name
Injury.Severity  \
0      United States        NaN         NaN          NaN
Fatal(2)
1      United States        NaN         NaN          NaN
Fatal(4)
2      United States  36.922223  -81.878056          NaN
Fatal(3)
3      United States        NaN         NaN          NaN
Fatal(2)
4      United States        NaN         NaN          NaN
Fatal(1)
...              ...        ...         ...          ...              .
..
88884  United States        NaN         NaN          NaN
Minor
88885  United States        NaN         NaN          NaN
NaN
88886  United States    341525N    1112021W       PAYSON       Non-
Fatal
88887  United States        NaN         NaN          NaN
NaN
88888  United States        NaN         NaN          NaN
Minor

      Aircraft.damage  ... Schedule Purpose.of.flight
Air.carrier  \
0           Destroyed  ...      NaN          Personal
NaN
1           Destroyed  ...      NaN          Personal
NaN
2           Destroyed  ...      NaN          Personal
NaN
3           Destroyed  ...      NaN          Personal
NaN
4           Destroyed  ...      NaN          Personal
NaN
...               ...  ...      ...               ...
...
88884             NaN  ...      NaN          Personal
NaN
88885             NaN  ...      NaN               NaN
```

```
NaN
88886     Substantial  ...      NaN           Personal
NaN
88887             NaN  ...      NaN           Personal  MC CESSNA 210N
LLC
88888             NaN  ...      NaN           Personal
NaN

      Total.Fatal.Injuries Total.Serious.Injuries
Total.Minor.Injuries  \
0                      2.0                     0.0
0.0
1                      4.0                     0.0
0.0
2                      3.0                     NaN
NaN
3                      2.0                     0.0
0.0
4                      1.0                     2.0
NaN
...                    ...                     ...                    ..
.
88884                  0.0                     1.0
0.0
88885                  0.0                     0.0
0.0
88886                  0.0                     0.0
0.0
88887                  0.0                     0.0
0.0
88888                  0.0                     1.0
0.0

      Total.Uninjured Weather.Condition Broad.phase.of.flight
Report.Status
0                 0.0               UNK                Cruise
Probable Cause
1                 0.0               UNK              Unknown
Probable Cause
2                 NaN               IMC                Cruise
Probable Cause
3                 0.0               IMC                Cruise
Probable Cause
4                 0.0               VMC             Approach
Probable Cause
...               ...               ...                   ...
...
88884             0.0           Unknown                   NaN
NaN
```

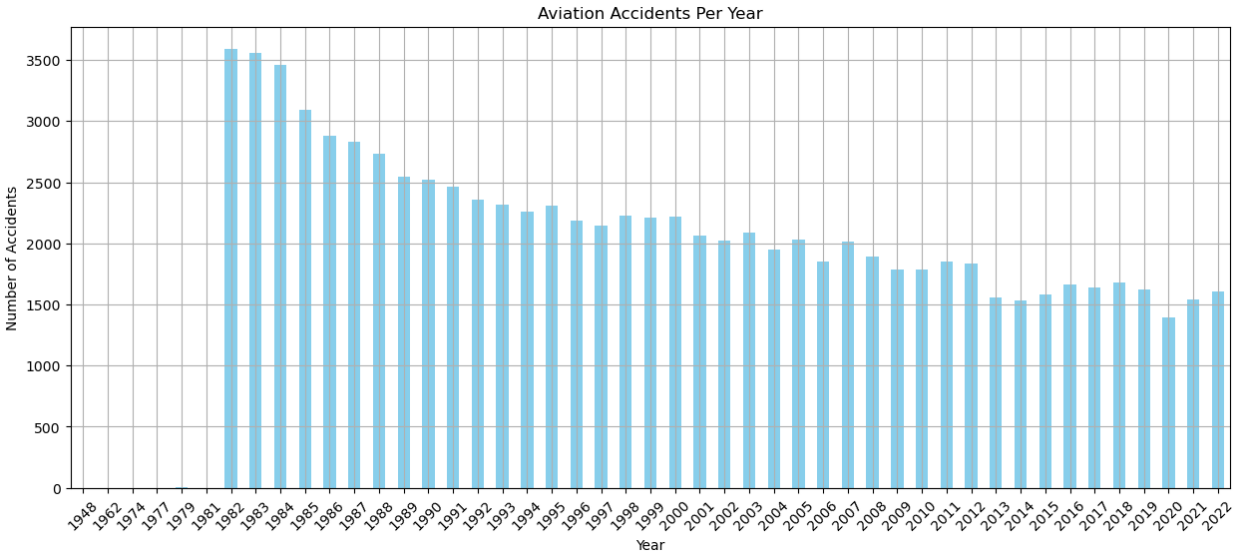
```
88885                0.0             Unknown                       NaN
NaN
88886                1.0                 VMC                       NaN
NaN
88887                0.0             Unknown                       NaN
NaN
88888                1.0             Unknown                       NaN
NaN

[88889 rows x 28 columns]>
```

```
aviation_df['Event.Date'] = pd.to_datetime(aviation_df['Event.Date'],
errors='coerce')
aviation_df['Year'] = aviation_df['Event.Date'].dt.year

import matplotlib.pyplot as plt
#group by year and count accidents
yearly_counts = aviation_df['Year'].value_counts().sort_index()

plt.figure(figsize=(12,6))
plt.plot(yearly_counts.index, yearly_counts.values, marker='o')
plt.title("Aviation Accidents Per Year")
plt.xlabel("Year")
plt.ylabel("Number of Accidents")
plt.grid(True)
plt.tight_layout()
plt.show()
```




```
yearly_counts.plot(kind='bar', figsize=(15,6), color='skyblue')
plt.title("Aviation Accidents Per Year")
```

```
plt.xlabel("Year")
plt.ylabel("Number of Accidents")
plt.xticks(rotation=45)
plt.grid(True)
plt.show()
```




```
#to look for extremes
aviation_df['Total.Fatal.Injuries'].describe()
```

```
count    77488.000000
mean         0.647855
std          5.485960
min          0.000000
25%          0.000000
50%          0.000000
75%          0.000000
max        349.000000
Name: Total.Fatal.Injuries, dtype: float64
```

```
import seaborn as sns
import matplotlib.pyplot as plt
#visually spot outliers
plt.figure(figsize=(10, 4))
sns.boxplot(x=aviation_df['Total.Fatal.Injuries'])
plt.title("Outliers in Fatal Injuries")
plt.show()
#any dots far from the box are outliers
```


```
#actual outlier rows
aviation_df.sort_values(by='Total.Fatal.Injuries',
ascending=False).head(10)
```

```
             Event.Id Accident.Number Event.Date
Location  \
40881  20020124X00116     DCA97WA007B 1996-11-12           New Delhi,
India
40882  20020124X00116     DCA97WA007A 1996-11-12           New Delhi,
India
75437  20140718X92314      DCA14RA127 2014-07-17           Hrabove,
Ukraine
22082  20001213X27403      DCA89RA014 1988-12-21  LOCKERBIE, United
Kingdom
51769  20011130X02321      DCA02MA001 2001-11-12           Belle
Harbor, NY
13597  20001214X38384      DCA86RA010 1985-12-12             GANDER,
Canada
74808  20140308X91420      DCA14RA076 2014-03-08     Kuala Lampur,
Malaysia
40104  20001208X06204      DCA96MA070 1996-07-17          EAST
MORICHES, NY
44807  20001211X11037      DCA98RA085 1998-09-02        NOVA SCOTIA,
Canada
42415  20001208X08606      DCA97MA058 1997-08-06            NIMITZ
HILL, GU

               Country Latitude Longitude
Airport.Name  \
40881            India      NaN       NaN
NaN
```

```
40882           India      NaN       NaN
NaN
75437         Ukraine      NaN       NaN
NaN
22082  United Kingdom      NaN       NaN
NaN
51769   United States      NaN       NaN  John F. Kennedy
International
13597          Canada      NaN       NaN           GANDER
INTERNATIONAL
74808        Malaysia      NaN       NaN     Kuala Lumper
International
40104   United States      NaN       NaN
NaN
44807          Canada      NaN       NaN
NaN
42415   United States      NaN       NaN      AGANA INTERNATIONAL
AIRPO

      Injury.Severity Aircraft.damage  ... Purpose.of.flight  \
40881      Fatal(349)             NaN  ...               NaN
40882      Fatal(349)             NaN  ...               NaN
75437           Fatal       Destroyed  ...               NaN
22082      Fatal(270)       Destroyed  ...           Unknown
51769      Fatal(265)       Destroyed  ...               NaN
13597      Fatal(256)       Destroyed  ...           Unknown
74808           Fatal       Destroyed  ...               NaN
40104      Fatal(230)       Destroyed  ...           Unknown
44807      Fatal(229)       Destroyed  ...           Unknown
42415      Fatal(228)       Destroyed  ...           Unknown

                           Air.carrier Total.Fatal.Injuries  \
40881                             NaN                349.0
40882                             NaN                349.0
75437  MALAYSIAN AIRLINES SYSTEM BERHAD                295.0
22082                             NaN                270.0
51769                             NaN                265.0
13597                             NaN                256.0
74808               Malaysian Airlines                239.0
40104                             NaN                230.0
44807                             NaN                229.0
42415                             NaN                228.0

      Total.Serious.Injuries Total.Minor.Injuries  Total.Uninjured  \
40881                    NaN                  NaN              NaN
40882                    NaN                  NaN              NaN
75437                    0.0                  0.0              0.0
22082                    2.0                  3.0              0.0
51769                    NaN                  NaN              NaN
13597                    0.0                  0.0              0.0
```

```
74808                    0.0                  0.0              0.0
40104                    0.0                  0.0              0.0
44807                    0.0                  0.0              NaN
42415                   26.0                  NaN              NaN

      Weather.Condition Broad.phase.of.flight   Report.Status  Year
40881           Unknown                   NaN         Foreign  1996
40882           Unknown                   NaN         Foreign  1996
75437           Unknown                   NaN             NaN  2014
22082               UNK                   NaN         Foreign  1988
51769               VMC              Takeoff  Probable Cause  2001
13597               IMC                   NaN         Foreign  1985
74808           Unknown                   NaN             NaN  2014
40104               VMC                 Climb  Probable Cause  1996
44807               UNK                   NaN         Foreign  1998
42415               IMC              Approach  Probable Cause  1997

[10 rows x 29 columns]
```

```
# Summary and Recommendations

from IPython.display import Markdown

Markdown("""
#Summary of Findings

- Most aviation accidents occurred between the 1970s–1990s.
- Weather condition is often unknown or VFR (visual flight rules).
- Some accidents had extremely high fatalities (likely commercial
airliners).

#Business Recommendations

1. *Focus Safety Checks on Older Aircraft Models*
   Older aircraft are more likely to be involved in incidents.

2. *Improve Data Collection for Weather Conditions*
   Many records have missing or unknown weather – more detail can help
prevent accidents.

3. *Target Training in High-Incident Regions*
   Use location data to identify hotspots and prioritize safety
education.
""")
```

```
<IPython.core.display.Markdown object>
```

```
aviation_df.to_csv("cleaned_aviation_data.csv", index=False)
```