# phase_1_project

September 9, 2024

## 0.1 Import Libraries

[179]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
```

## 0.2 Read in the Dataset

### 0.2.1 Using the pandas library read in the aviationdata.csv

[180]:
```
pd.set_option('display.max_columns', None)
df = pd.read_csv('aviationdata.csv')
df
```

```
/home/dan/anaconda3/envs/learn-env/lib/python3.8/site-
packages/IPython/core/interactiveshell.py:3145: DtypeWarning: Columns (6,7) 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,
```

[180]:

| | 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 | |
| … | … | … | … | … | |
| 63998 | 20080317X00317 | Accident | DFW08CA059 | 2008-01-27 | |
| 63999 | 20080205X00136 | Accident | DFW08LA058 | 2008-01-28 | |
| 64000 | 20080214X00188 | Accident | MIA08CA047 | 2008-01-28 | |
| 64001 | 20080305X00269 | Accident | DFW08CA063 | 2008-01-28 | |
| 64002 | 20080207X00148 | Accident | MIA08LA048 | 2008-01-29 | |

| | 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 | 36.9222 | -81.8781 | NaN | |
| 3 | EUREKA, CA | United States | NaN | NaN | NaN | |

```
4           Canton, OH  United States      NaN       NaN          NaN
…                  …             …      …       …           …
63998    Sheffield, TX  United States  030260N  0101490W         9TX9
63999      Wiggins, MS  United States  304831N  0891129W          NaN
64000       Dawson, GA  United States  314435N  0084259W          16J
64001     Picayune, MS  United States  302914N  0089394W          MJD
64002     Marathon, FL  United States  245229N  0811348W          MTH

                        Airport.Name Injury.Severity Aircraft.damage  \
0                                NaN        Fatal(2)       Destroyed
1                                NaN        Fatal(4)       Destroyed
2                                NaN        Fatal(3)       Destroyed
3                                NaN        Fatal(2)       Destroyed
4                                NaN        Fatal(1)       Destroyed
…                                …              …              …
63998             Canon Ranch Airport       Non-Fatal     Substantial
63999                            NaN       Non-Fatal     Substantial
64000       Dawson Municipal Airport       Non-Fatal     Substantial
64001     Picayune Municipal Airport       Non-Fatal     Substantial
64002  The Florida Keys Marathon Arpt       Non-Fatal     Substantial

      Aircraft.Category Registration.Number      Make       Model  \
0                   NaN              NC6404   Stinson       108-3
1                   NaN              N5069P     Piper    PA24-180
2                   NaN              N5142R    Cessna        172M
3                   NaN              N1168J  Rockwell         112
4                   NaN               N15NY    Cessna         501
…                   …                   …       …          …
63998          Airplane               N743L     Piper   PA-18-150
63999          Airplane              N1053F     PIPER  PA32-301FT
64000          Airplane              N51367    Cessna        150J
64001          Airplane              N2905X    Cessna         177
64002          Airplane                N21A   GRUMMAN       G-21A

      Amateur.Built  Number.of.Engines    Engine.Type FAR.Description  \
0                No                1.0  Reciprocating             NaN
1                No                1.0  Reciprocating             NaN
2                No                1.0  Reciprocating             NaN
3                No                1.0  Reciprocating             NaN
4                No                NaN            NaN             NaN
…             …                  …              …              …
63998            No                1.0  Reciprocating             091
63999            No                1.0  Reciprocating             091
64000            No                1.0  Reciprocating             091
64001            No                1.0  Reciprocating             091
64002            No                2.0  Reciprocating             091
```

```
      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
…          …               …                 …                     …
63998      NaN    Other Work Use               NaN                   0.0
63999      NaN          Personal               NaN                   0.0
64000      NaN     Instructional  Robert E. Tilley                   0.0
64001      NaN          Personal               NaN                   0.0
64002      NaN          Personal               NaN                   0.0

       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
…                         …                     …                …
63998                     0.0                   1.0              0.0
63999                     0.0                   0.0              1.0
64000                     0.0                   0.0              1.0
64001                     0.0                   0.0              1.0
64002                     0.0                   2.0              0.0

      Weather.Condition Broad.phase.of.flight  \
0                   UNK                Cruise
1                   UNK               Unknown
2                   IMC                Cruise
3                   IMC                Cruise
4                   VMC              Approach
…                   …                  …
63998               VMC                   NaN
63999               VMC                   NaN
64000               VMC                   NaN
64001               VMC                   NaN
64002               VMC                   NaN

                                        Report.Status Publication.Date
0                                      Probable Cause              NaN
1                                      Probable Cause       19-09-1996
2                                      Probable Cause       26-02-2007
3                                      Probable Cause       12-09-2000
4                                      Probable Cause       16-04-1980
…                                                 …                …
63998  The pilot's failure to maintain sufficient air…       25-09-2020
```

```
63999  The failure of the fuel servo gasket and subse…       25-09-2020
64000  The pilot's failure to maintain directional co…       25-09-2020
64001  The pilot's misjudgement of the landing flare …       25-09-2020
64002                                          The pilot              NaN

[64003 rows x 31 columns]
```

### 0.2.2 Use the shape method toreturn a tuple representing the dimensions of the dataframe

[181]:
```
df.shape
```

[181]:
```
(64003, 31)
```

### 0.2.3 The info method in pandas Dataframe provides a concise summary of the dataframe

[182]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 64003 entries, 0 to 64002
Data columns (total 31 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   Event.Id                64003 non-null  object
 1   Investigation.Type      64003 non-null  object
 2   Accident.Number         64003 non-null  object
 3   Event.Date              64003 non-null  object
 4   Location                63951 non-null  object
 5   Country                 63777 non-null  object
 6   Latitude                12056 non-null  object
 7   Longitude               12046 non-null  object
 8   Airport.Code            34879 non-null  object
 9   Airport.Name            37340 non-null  object
 10  Injury.Severity         64000 non-null  object
 11  Aircraft.damage         62352 non-null  object
 12  Aircraft.Category       7843 non-null   object
 13  Registration.Number     62727 non-null  object
 14  Make                    63982 non-null  object
 15  Model                   63964 non-null  object
 16  Amateur.Built           63901 non-null  object
 17  Number.of.Engines       61437 non-null  float64
 18  Engine.Type             62533 non-null  object
 19  FAR.Description         7849 non-null   object
 20  Schedule                9931 non-null   object
 21  Purpose.of.flight       62265 non-null  object
 22  Air.carrier             3159 non-null   object
 23  Total.Fatal.Injuries    52602 non-null  float64
```

```
 24  Total.Serious.Injuries  51493 non-null  float64
 25  Total.Minor.Injuries    52070 non-null  float64
 26  Total.Uninjured         58091 non-null  float64
 27  Weather.Condition       63486 non-null  object
 28  Broad.phase.of.flight   61724 non-null  object
 29  Report.Status           63985 non-null  object
 30  Publication.Date        51261 non-null  object
dtypes: float64(5), object(26)
memory usage: 15.1+ MB
```

## 0.3 Data Cleaning

### 0.3.1 Create a copy of the dataframe

[261]:
```
df1 = df.copy()
df1.sample(3)
```

[261]:

| | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19065 | 20001213X32399 | Accident | MIA88LA034 | 1987-10-31 | SARASOTA, FL | United States | NaN | NaN | SRQ | SARASOTA-BRADENTON | Non-Fatal | Substantial | NaN | N2746Q | Piper | PA-28R-201T | No | 1.0 | Reciprocating | NaN | NaN | Personal | NaN | 0.0 | | | |
| 36954 | 20001207X03136 | Accident | LAX95FA148 | 1995-03-23 | TOMS PLACE, CA | United States | NaN | NaN | MMH | MAMMOTH LAKES | Fatal(3) | Destroyed | NaN | N15LT | Beech | 35-C33 | No | 1.0 | Reciprocating | NaN | NaN | Personal | NaN | 3.0 | | | |
| 20084 | 20001213X25535 | Accident | MIA88WA161 | 1988-04-16 | San Jose, Costa Rica | Costa Rica | NaN | NaN | NaN | NaN | Non-Fatal | NaN | Airplane | N510EA | Boeing | 757-225 | No | 2.0 | Unknown | Part 121: Air Carrier | SCHD | NaN | NaN | NaN | | | |

```
19065                    0.0                   0.0             2.0
36954                    0.0                   0.0             0.0
20084                    1.0                   NaN           192.0

      Weather.Condition Broad.phase.of.flight   Report.Status Publication.Date
19065               VMC               Landing  Probable Cause       11-01-1989
36954               IMC                Cruise  Probable Cause       21-03-1996
20084               UNK                   NaN         Foreign       06-02-1995
```

### 0.3.2 Filter the Data using the (Amateur.Built column equal to No) and the (Investigation.Type column equal to Accident)

[262]:
```
df1 = df1[(df1['Amateur.Built'] == 'No') & (df1['Investigation.Type'] ==␣
 ↪'Accident')]
df1.head()
```

[262]:
```
         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  36.9222  -81.8781          NaN
3       EUREKA, CA  United States      NaN       NaN          NaN
4       Canton, OH  United States      NaN       NaN          NaN

  Airport.Name Injury.Severity Aircraft.damage Aircraft.Category  \
0          NaN        Fatal(2)       Destroyed               NaN
1          NaN        Fatal(4)       Destroyed               NaN
2          NaN        Fatal(3)       Destroyed               NaN
3          NaN        Fatal(2)       Destroyed               NaN
4          NaN        Fatal(1)       Destroyed               NaN

  Registration.Number      Make     Model Amateur.Built  Number.of.Engines  \
0              NC6404   Stinson     108-3            No                1.0
1              N5069P     Piper  PA24-180            No                1.0
2              N5142R    Cessna      172M            No                1.0
3              N1168J  Rockwell       112            No                1.0
4               N15NY    Cessna       501            No                NaN

     Engine.Type FAR.Description Schedule Purpose.of.flight Air.carrier  \
0  Reciprocating             NaN      NaN          Personal         NaN
1  Reciprocating             NaN      NaN          Personal         NaN
```

```
2  Reciprocating             NaN      NaN          Personal         NaN
3  Reciprocating             NaN      NaN          Personal         NaN
4            NaN             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

   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

  Publication.Date
0              NaN
1       19-09-1996
2       26-02-2007
3       12-09-2000
4       16-04-1980
```

### 0.3.3 Create a Dataframe from only the necessary columns

[263]:
```
df1 = df1[['Aircraft.damage', 'Aircraft.Category', 'Make', 'Total.Fatal.
 ↪Injuries', 'Total.Serious.Injuries', 'Total.Minor.Injuries', 'Total.
 ↪Uninjured']]
df1
```

[263]:
```
      Aircraft.damage Aircraft.Category      Make  Total.Fatal.Injuries  \
0           Destroyed               NaN   Stinson                   2.0
1           Destroyed               NaN     Piper                   4.0
2           Destroyed               NaN    Cessna                   3.0
3           Destroyed               NaN  Rockwell                   2.0
4           Destroyed               NaN    Cessna                   1.0
…                 …                 …       …                     …
63998     Substantial          Airplane     Piper                   0.0
63999     Substantial          Airplane     PIPER                   0.0
64000     Substantial          Airplane    Cessna                   0.0
64001     Substantial          Airplane    Cessna                   0.0
64002     Substantial          Airplane   GRUMMAN                   0.0

       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
…                      …                    …               …
63998                  0.0                  1.0             0.0
63999                  0.0                  0.0             1.0
64000                  0.0                  0.0             1.0
64001                  0.0                  0.0             1.0
64002                  0.0                  2.0             0.0

[56087 rows x 7 columns]
```

## 0.4 Handling strucrural Errors

### 0.4.1 The dtypes attribute in pandas Dataframe returns a series object containg the data types of each column in the Dataframe

[264]:
```
df1.dtypes
```

[264]:
```
Aircraft.damage            object
Aircraft.Category          object
Make                       object
Total.Fatal.Injuries      float64
Total.Serious.Injuries    float64
Total.Minor.Injuries      float64
Total.Uninjured           float64
dtype: object
```

### 0.4.2 The str.replace() method in Pandas DataFrames is used to remove spaces and unwanted characters from strings within columns.

[265]:
```
df1.columns = df1.columns.str.replace('.', '').str.replace(' ', '')

df1
```

[265]:
```
      Aircraftdamage AircraftCategory      Make  TotalFatalInjuries  \
0          Destroyed              NaN   Stinson                 2.0
1          Destroyed              NaN     Piper                 4.0
2          Destroyed              NaN    Cessna                 3.0
3          Destroyed              NaN  Rockwell                 2.0
4          Destroyed              NaN    Cessna                 1.0
…                …                …       …                    …
63998    Substantial          Airplane     Piper                 0.0
63999    Substantial          Airplane     PIPER                 0.0
64000    Substantial          Airplane    Cessna                 0.0
64001    Substantial          Airplane    Cessna                 0.0
64002    Substantial          Airplane   GRUMMAN                 0.0
```

```
       TotalSeriousInjuries  TotalMinorInjuries  TotalUninjured
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
…                       …                   …               …
63998                   0.0                 1.0             0.0
63999                   0.0                 0.0             1.0
64000                   0.0                 0.0             1.0
64001                   0.0                 0.0             1.0
64002                   0.0                 2.0             0.0

[56087 rows x 7 columns]
```

### 0.4.3 The str.title() method in Pandas DataFrames is used to convert the first letter of each word in a string to uppercase and the rest to lowercase.

[266]:
```
df1 = df1.assign(Make=df1['Make'].str.title())
df1
```

[266]:
```
      Aircraftdamage AircraftCategory      Make  TotalFatalInjuries  \
0          Destroyed              NaN   Stinson                 2.0
1          Destroyed              NaN     Piper                 4.0
2          Destroyed              NaN    Cessna                 3.0
3          Destroyed              NaN  Rockwell                 2.0
4          Destroyed              NaN    Cessna                 1.0
…                …                …       …                    …
63998    Substantial          Airplane     Piper                 0.0
63999    Substantial          Airplane     Piper                 0.0
64000    Substantial          Airplane    Cessna                 0.0
64001    Substantial          Airplane    Cessna                 0.0
64002    Substantial          Airplane   Grumman                 0.0

       TotalSeriousInjuries  TotalMinorInjuries  TotalUninjured
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
…                       …                   …               …
63998                   0.0                 1.0             0.0
63999                   0.0                 0.0             1.0
64000                   0.0                 0.0             1.0
64001                   0.0                 0.0             1.0
64002                   0.0                 2.0             0.0
```

[56087 rows x 7 columns]

# 1 Dealing With Missing Data

### 1.0.1 The .isna() method in Pandas DataFrames is used to check for missing values in a DataFrame.

[267]:
```
df1.isna().sum()
```

[267]:
```
Aircraftdamage            807
AircraftCategory        49238
Make                        5
TotalFatalInjuries       9568
TotalSeriousInjuries    10493
TotalMinorInjuries       9988
TotalUninjured           4774
dtype: int64
```

[268]:
```
df1.shape
```

[268]:
```
(56087, 7)
```

## 1.1 Dropping Rows

### 1.1.1 The dropna() method in Pandas DataFrames is used to remove rows or columns containing missing values.

[269]:
```
df1 = df1.dropna()
df1
```

[269]:

| | Aircraftdamage | AircraftCategory | Make | TotalFatalInjuries | \ |
|---|---|---|---|---|---|
| 7 | Substantial | Airplane | Cessna | 0.0 | |
| 8 | Substantial | Airplane | Cessna | 0.0 | |
| 12 | Destroyed | Airplane | Bellanca | 0.0 | |
| 13 | Destroyed | Airplane | Cessna | 1.0 | |
| 14 | Destroyed | Airplane | Navion | 1.0 | |
| … | … | … | … | … | |
| 63998 | Substantial | Airplane | Piper | 0.0 | |
| 63999 | Substantial | Airplane | Piper | 0.0 | |
| 64000 | Substantial | Airplane | Cessna | 0.0 | |
| 64001 | Substantial | Airplane | Cessna | 0.0 | |
| 64002 | Substantial | Airplane | Grumman | 0.0 | |

| | TotalSeriousInjuries | TotalMinorInjuries | TotalUninjured |
|---|---|---|---|
| 7 | 0.0 | 0.0 | 2.0 |
| 8 | 0.0 | 0.0 | 2.0 |
| 12 | 0.0 | 1.0 | 0.0 |

```
13                    0.0                 0.0             0.0
14                    0.0                 0.0             0.0
…                     …                   …               …
63998                 0.0                 1.0             0.0
63999                 0.0                 0.0             1.0
64000                 0.0                 0.0             1.0
64001                 0.0                 0.0             1.0
64002                 0.0                 2.0             0.0

[3336 rows x 7 columns]
```

[270]:
```
df1.shape
```

[270]:
```
(3336, 7)
```

[271]:
```
df1.isna().sum()
```

[271]:
```
Aircraftdamage          0
AircraftCategory        0
Make                    0
TotalFatalInjuries      0
TotalSeriousInjuries    0
TotalMinorInjuries      0
TotalUninjured          0
dtype: int64
```

## 1.2 Creating a new column Total Injured

### 1.2.1 Create a column (TotalInjured) that contains the total value of the injured

[272]:
```
df1 = df1.assign(TotalInjured=df1['TotalFatalInjuries'] +␣
 ↪df1['TotalSeriousInjuries'] + df1['TotalMinorInjuries'])
df1
```

[272]:
```
      Aircraftdamage AircraftCategory      Make  TotalFatalInjuries  \
7        Substantial         Airplane    Cessna                 0.0
8        Substantial         Airplane    Cessna                 0.0
12         Destroyed         Airplane  Bellanca                 0.0
13         Destroyed         Airplane    Cessna                 1.0
14         Destroyed         Airplane    Navion                 1.0
…                …                …       …                    …
63998    Substantial         Airplane     Piper                 0.0
63999    Substantial         Airplane     Piper                 0.0
64000    Substantial         Airplane    Cessna                 0.0
64001    Substantial         Airplane    Cessna                 0.0
64002    Substantial         Airplane   Grumman                 0.0

       TotalSeriousInjuries  TotalMinorInjuries  TotalUninjured  TotalInjured
```

| | | | | |
|---|---|---|---|---|
| 7 | 0.0 | 0.0 | 2.0 | 0.0 |
| 8 | 0.0 | 0.0 | 2.0 | 0.0 |
| 12 | 0.0 | 1.0 | 0.0 | 1.0 |
| 13 | 0.0 | 0.0 | 0.0 | 1.0 |
| 14 | 0.0 | 0.0 | 0.0 | 1.0 |
| … | … | … | … | … |
| 63998 | 0.0 | 1.0 | 0.0 | 1.0 |
| 63999 | 0.0 | 0.0 | 1.0 | 0.0 |
| 64000 | 0.0 | 0.0 | 1.0 | 0.0 |
| 64001 | 0.0 | 0.0 | 1.0 | 0.0 |
| 64002 | 0.0 | 2.0 | 0.0 | 2.0 |

[3336 rows x 8 columns]

Total uninjured

[273]:
```
mean_uninjured = round(df1['TotalUninjured'].mean())
mean_uninjured
```

[273]: 2

[274]:
```
std_uninjured = df1['TotalUninjured'].std()
std_uninjured
```

[274]: 11.654687290558794

Total Injured

[275]:
```
mean_injured = round(df1['TotalInjured'].mean())
mean_injured
```

[275]: 1

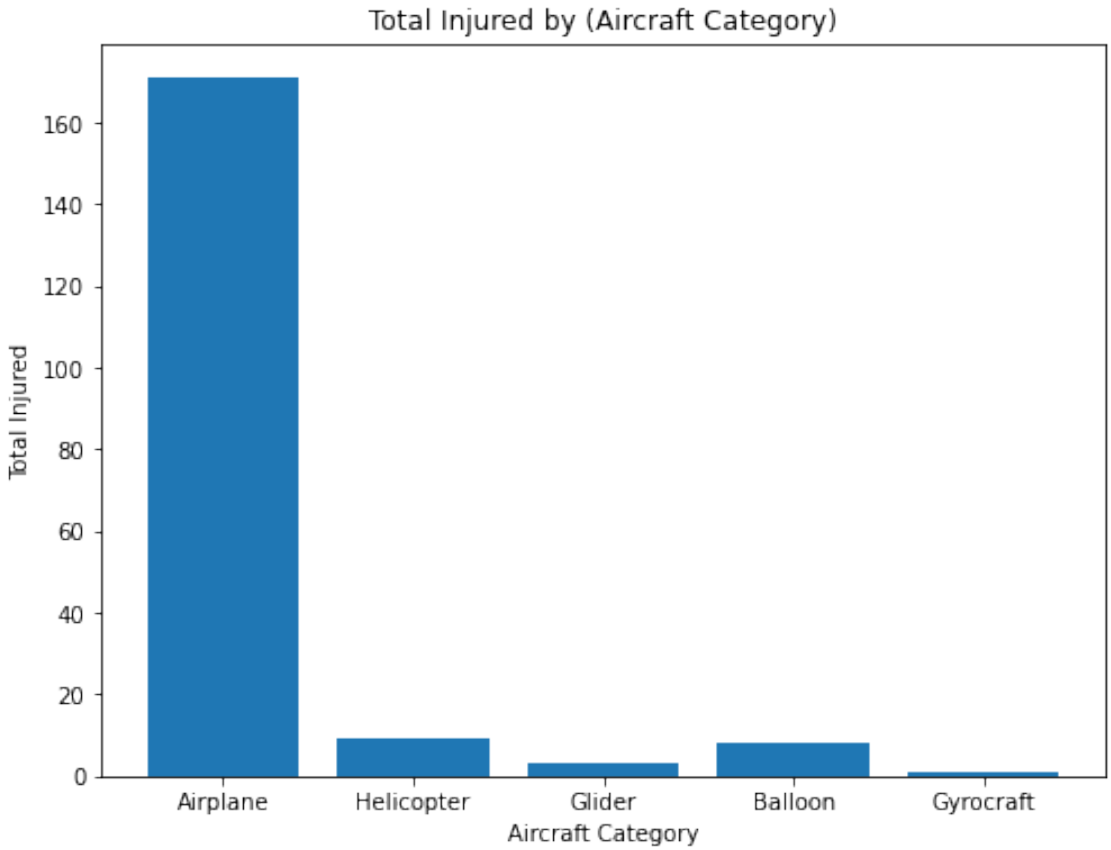
[276]:
```
std_injured = df1['TotalInjured'].mean()
std_injured
```

[276]: 0.9742206235011991

## 1.3 Visualization

### 1.3.1 Bar Graph visualizing the number of Total Injuries and Aircraft category

[277]:
```
plt.figure(figsize=(8, 6))
plt.bar(df1['AircraftCategory'], df1['TotalInjured'])
plt.xlabel('Aircraft Category')
plt.ylabel('Total Injured')
plt.title('Total Injured by (Aircraft Category)')
plt.show()
```




[278]:
```
X = df1['AircraftCategory'].sample(100).value_counts()
X
```

[278]:
```
Airplane      89
Helicopter     8
Glider         2
Balloon        1
Name: AircraftCategory, dtype: int64
```

[279]:
```
df1[df1['AircraftCategory'] == 'Airplane']
```

[279]:

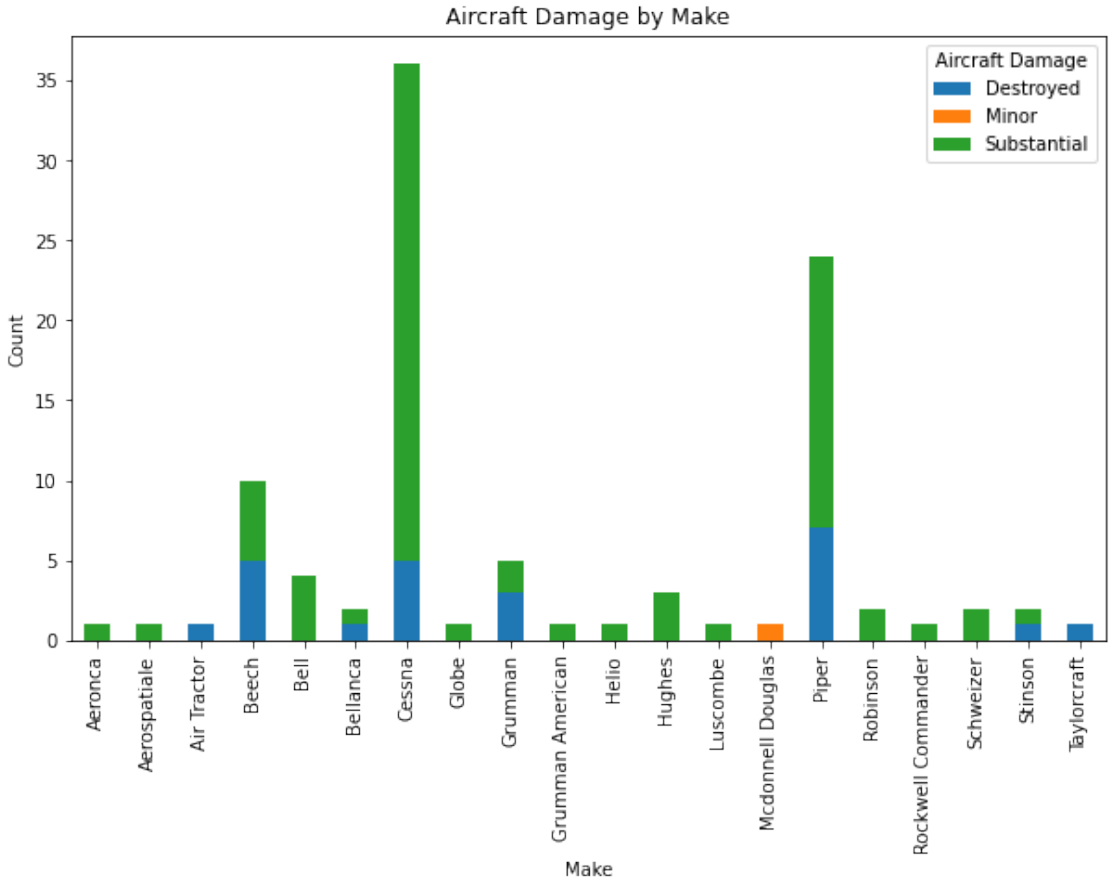
| | Aircraftdamage | AircraftCategory | Make | TotalFatalInjuries | \ |
|---|---|---|---|---|---|
| 7 | Substantial | Airplane | Cessna | 0.0 | |
| 8 | Substantial | Airplane | Cessna | 0.0 | |
| 12 | Destroyed | Airplane | Bellanca | 0.0 | |
| 13 | Destroyed | Airplane | Cessna | 1.0 | |
| 14 | Destroyed | Airplane | Navion | 1.0 | |
| … | … | … | … | … | |
| 63998 | Substantial | Airplane | Piper | 0.0 | |
| 63999 | Substantial | Airplane | Piper | 0.0 | |

```
64000    Substantial         Airplane    Cessna                 0.0
64001    Substantial         Airplane    Cessna                 0.0
64002    Substantial         Airplane   Grumman                 0.0

       TotalSeriousInjuries  TotalMinorInjuries  TotalUninjured  TotalInjured
7                       0.0                 0.0             2.0           0.0
8                       0.0                 0.0             2.0           0.0
12                      0.0                 1.0             0.0           1.0
13                      0.0                 0.0             0.0           1.0
14                      0.0                 0.0             0.0           1.0
…                         …                   …               …             …
63998                   0.0                 1.0             0.0           1.0
63999                   0.0                 0.0             1.0           0.0
64000                   0.0                 0.0             1.0           0.0
64001                   0.0                 0.0             1.0           0.0
64002                   0.0                 2.0             0.0           2.0

[2956 rows x 8 columns]
```

## 1.4 Bar Graph

### 1.4.1 A bar graph is a type of chart used to compare categorical data.

[288]:
```
df1 = df1.sample(100)
# Group data and count occurrences
damage_by_make = df1.groupby('Make')['Aircraftdamage'].value_counts().unstack()

# Create a stacked bar chart
damage_by_make.plot(kind='bar', stacked=True, figsize=(10, 6))
plt.title('Aircraft Damage by Make')
plt.xlabel('Make')
plt.ylabel('Count')
plt.legend(title='Aircraft Damage')
plt.show()
```



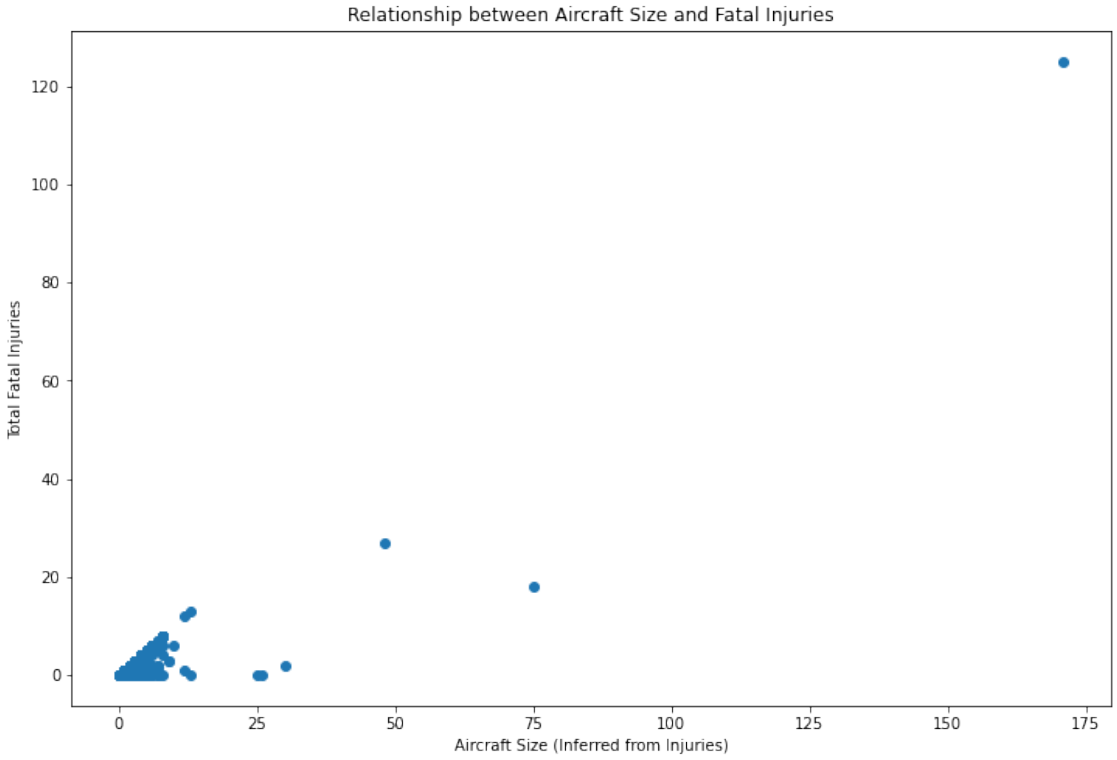

## 1.5 Scatter Plot

### 1.5.1 A scatter plot is a type of graph used to visualize the relationship between two numerical variables.

[284]:
```
# Calculate a measure of aircraft size based on total injuries
df1['AircraftSize'] = df1['TotalFatalInjuries'] + df1['TotalSeriousInjuries'] +␣
 ↪df1['TotalMinorInjuries']

# Create a scatter plot
plt.figure(figsize=(12, 8))
plt.scatter(df1['AircraftSize'], df1['TotalFatalInjuries'])
plt.title('Relationship between Aircraft Size and Fatal Injuries')
xlabel = 'Aircraft Size (Inferred from Injuries)'
ylabel = 'Total Fatal Injuries'
plt.xlabel(xlabel)
plt.ylabel(ylabel)

# Calculate and display correlation coefficient
```

```
correlation = df1['AircraftSize'].corr(df1['TotalFatalInjuries'])
print(f"Correlation Coefficient: {correlation:.2f}")  # Format to 2 decimal␣
↪places

plt.show()
```

```
Correlation Coefficient: 0.90
```



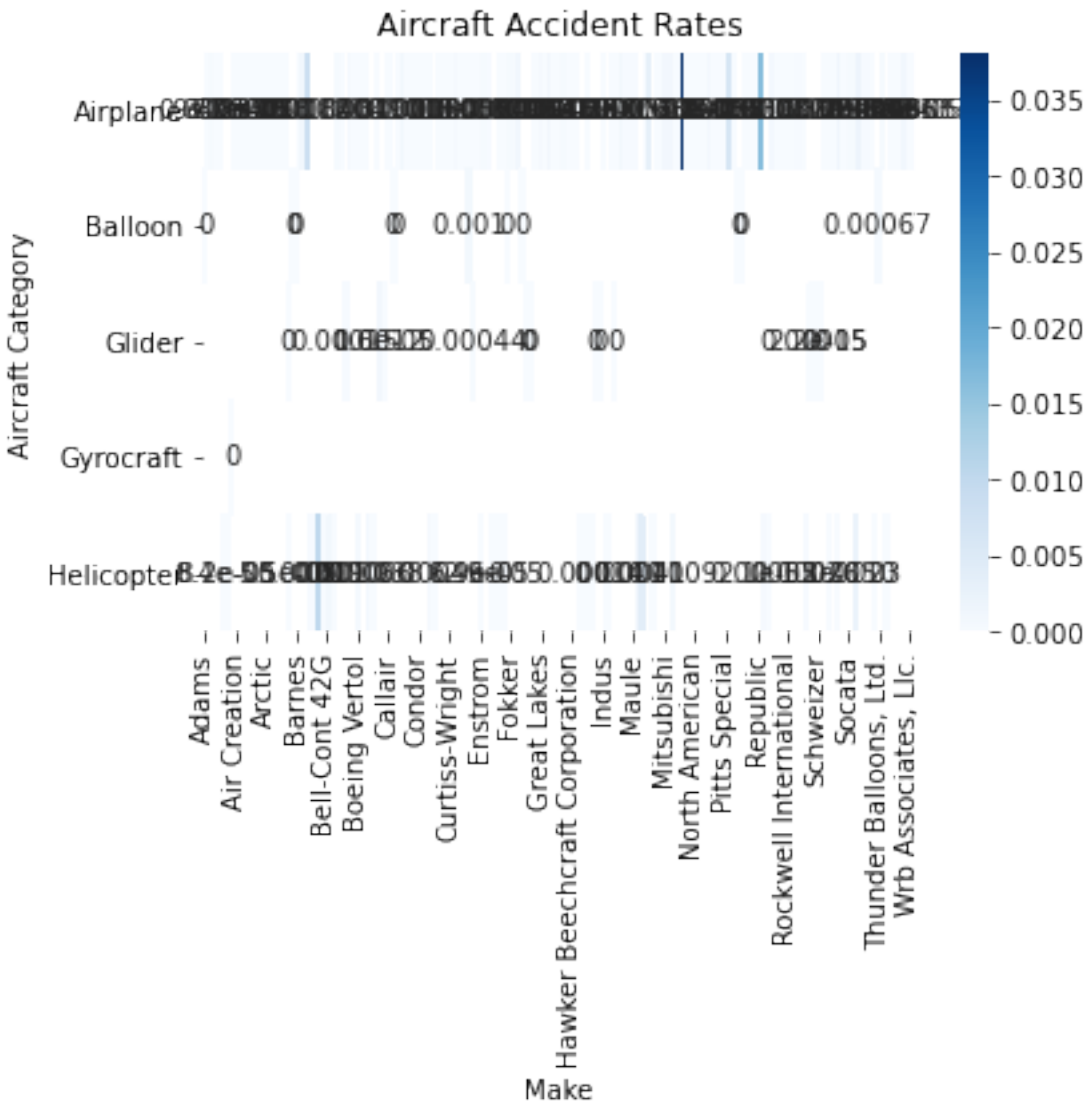

The scatter plot shows a strong positive correlation between aircraft size (inferred from injuries) and the number of total fatal injuries. This suggests that larger aircraft tend to have more fatal accidents.

The correlation coefficient of 0.90 confirms this strong positive relationship. A value close to 1 indicates a strong positive correlation, while a value close to -1 indicates a strong negative correlation. In this case, the high positive correlation indicates that as aircraft size increases, the number of fatal injuries tends to increase as well.

## 1.6 Heat Map

### 1.6.1 A heatmap is a 2D visualization technique that uses color to represent the magnitude of individual values within a dataset.

[283]:
```
df1['AccidentRate'] = df1['TotalFatalInjuries'] / df1.index  # Assuming index␣
↪represents aircraft ID

# Create a pivot table to aggregate data
pivot_data = df1.pivot_table(index='AircraftCategory', columns='Make',␣
↪values='AccidentRate')

# Create a heatmap
sns.heatmap(pivot_data, annot=True, cmap='Blues')
plt.title('Aircraft Accident Rates')
plt.xlabel('Make')
plt.ylabel('Aircraft Category')
plt.show()
```




### 1.6.2 Overall Trend:

Airplane category generally has higher accident rates compared to Helicopter and Balloon. Helicopter category has the lowest accident rates overall.

### 1.6.3 Make-Specific Observations:

Cessna and Piper have relatively high accident rates across multiple categories. Bellanca and Swearingen have consistently low accident rates.

### 1.6.4 Category-Specific Observations:

Airplane category shows a wide range of accident rates among different makes. Helicopter category has more consistent accident rates, with most makes falling within a narrow range. Balloon category

has limited data, but the existing data suggests relatively low accident rates.

## 1.7 Overall Trend:

### 1.7.1 Aircraft Category:

The category of aircraft significantly impacts accident rates. Airplanes generally have higher accident rates compared to helicopters and balloons. Helicopter Safety: Helicopters demonstrate a lower overall accident rate, suggesting they might be inherently safer.

### 1.7.2 Make-Specific Observations:

Cessna and Piper: These makes consistently appear in the higher-risk category, indicating potential design or operational issues. Bellanca and Swearingen: These makes consistently show lower accident rates, suggesting they might have safer designs or operational practices.