Final Project Submission

Please fill out:

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- Student pace: Full time
- Scheduled project review date/time:
- Instructor name: WILLIAM
- Blog post URL:

In [30]:

```
# Import the libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [31]:

```
#Loading the csv dataset
df = pd.read_csv("AviationData.csv", encoding="Latin1", low_memory=False)
```

In [32]:

```
#setting the default data view and viewing it
pd.set_option("display.max_columns", 500)
df.head()
```

Out[32]:

	Event.Id	Investigation.Type	Accident.Number	Event.Date	Location	Country	
0	20001218X45444	Accident	SEA87LA080	1948-10-24	MOOSE CREEK, ID	United States	
1	20001218X45447	Accident	LAX94LA336	1962-07-19	BRIDGEPORT, CA	United States	
2	20061025X01555	Accident	NYC07LA005	1974-08-30	Saltville, VA	United States	36
3	20001218X45448	Accident	LAX96LA321	1977-06-19	EUREKA, CA	United States	
4	20041105X01764	Accident	CHI79FA064	1979-08-02	Canton, OH	United States	

In [33]:

```
#Checking for columns
df.columns
```

Out[33]:

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

In [34]:

```
#Droppin the unwanted columns
columns_to_drop = ["Event.Id", "Investigation.Type", "Accident.Number", "Lati
df.drop(columns=columns_to_drop, axis=1, inplace=True)

#Check the remaining columns
print(df.columns)
```

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

In [35]:

```
print(df.dtypes)
```

```
Event.Date                 object
Location                   object
Country                    object
Injury.Severity            object
Aircraft.damage            object
Aircraft.Category          object
Make                       object
Model                      object
Amateur.Built              object
Number.of.Engines         float64
Engine.Type                object
Purpose.of.flight          object
Total.Fatal.Injuries      float64
Total.Serious.Injuries    float64
Total.Minor.Injuries      float64
Total.Uninjured           float64
Weather.Condition          object
Broad.phase.of.flight      object
dtype: object
```

In [36]:

```
#Changing the contents of the dataset to lowercase
df = df.applymap(lambda x: x.lower() if isinstance(x, str) else x)
df.head()
```

Out[36]:

	Event.Date	Location	Country	Injury.Severity	Aircraft.damage	Aircraft.Category	Make	M
0	1948-10-24	moose creek, id	united states	fatal(2)	destroyed	NaN	stinson	
1	1962-07-19	bridgeport, ca	united states	fatal(4)	destroyed	NaN	piper	l
2	1974-08-30	saltville, va	united states	fatal(3)	destroyed	NaN	cessna	
3	1977-06-19	eureka, ca	united states	fatal(2)	destroyed	NaN	rockwell	
4	1979-08-02	canton, oh	united states	fatal(1)	destroyed	NaN	cessna	

In [37]:

```
#checking for null values in the dataset
df.isnull().sum()
```

Out[37]:

```
Event.Date                   0
Location                    52
Country                    226
Injury.Severity           1000
Aircraft.damage           3194
Aircraft.Category        56602
Make                        63
Model                       92
Amateur.Built              102
Number.of.Engines         6084
Engine.Type               7077
Purpose.of.flight         6192
Total.Fatal.Injuries     11401
Total.Serious.Injuries   12510
Total.Minor.Injuries     11933
Total.Uninjured           5912
Weather.Condition         4492
Broad.phase.of.flight    27165
dtype: int64
```

In [38]:

```
#Filling the missing values in the categorical columns with "unknown"
categorical_columns = ["Location", "Country", "Injury.Severity", "Weather.Con
                       "Purpose.of.flight", "Broad.phase.of.flight", "Aircraf
for col in categorical_columns:
    df[col].fillna("unknown", inplace=True)
```

In [39]:

```
#Filling the missing values in the numerical columns with 0
numerical_columns = ['Total.Fatal.Injuries', 'Total.Serious.Injuries', 'Total
for col in numerical_columns:
    df[col].fillna(0, inplace=True)
```

In [40]:

```
#Check if any missing values remain
print(df.isnull().sum())
```

```
Event.Date                   0
Location                     0
Country                      0
Injury.Severity              0
Aircraft.damage              0
Aircraft.Category            0
Make                         0
Model                        0
Amateur.Built                0
Number.of.Engines         6084
Engine.Type                  0
Purpose.of.flight            0
Total.Fatal.Injuries         0
Total.Serious.Injuries       0
Total.Minor.Injuries         0
Total.Uninjured              0
Weather.Condition            0
Broad.phase.of.flight        0
dtype: int64
```

In [41]:

```
#Filling the missing values for 'Number.of.Engines' based on the mode for each
df['Number.of.Engines'] = df.groupby('Make')['Number.of.Engines'].transform(l

# Check for any remaining missing values
print(df.isnull().sum())
```

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

In [42]:
```
#Making the weather condition categories uniform by combining "unk" and "unkn
df['Weather.Condition'] = df['Weather.Condition'].replace({'unk': 'unknown'})
```

In [43]:
```
#Checking for duplicate rows
duplicate_rows = df.duplicated()
print(f"Number of duplicate rows: {duplicate_rows.sum()}")

#Display duplicate rows
print(df[df.duplicated()])
```

```
Number of duplicate rows: 35
       Event.Date          Location        Country Injury.Severity  \
1371   1982-05-28    evansville, in  united states       non-fatal
3082   1982-10-18    gulf of mexico gulf of mexico        fatal(3)
4761   1983-05-22    bridgeport, ca  united states        fatal(1)
7941   1984-04-13        deland, fl  united states       non-fatal
8661   1984-06-18      portland, ar  united states       non-fatal
13532  1985-11-30     san pedro, ca  united states        fatal(1)
19820  1988-03-10    greensboro, nc  united states        incident
21077  1988-08-05       atlanta, ga  united states        incident
22453  1989-03-01       houston, tx  united states        incident
24878  1990-02-09     teterboro, nj  united states       non-fatal
26868  1990-10-20          kent, oh  united states       non-fatal
27496  1991-03-02        marana, az  united states       non-fatal
27811  1991-04-19    santa rosa, nm  united states       non-fatal
28706  1991-07-31        silica, ks  united states        fatal(2)
30247  1992-04-23       branson, mo  united states       non-fatal
31502  1992-09-21       orlando, fl  united states       non-fatal
34847  1994-04-10    okeechobee, fl  united states       non-fatal
```

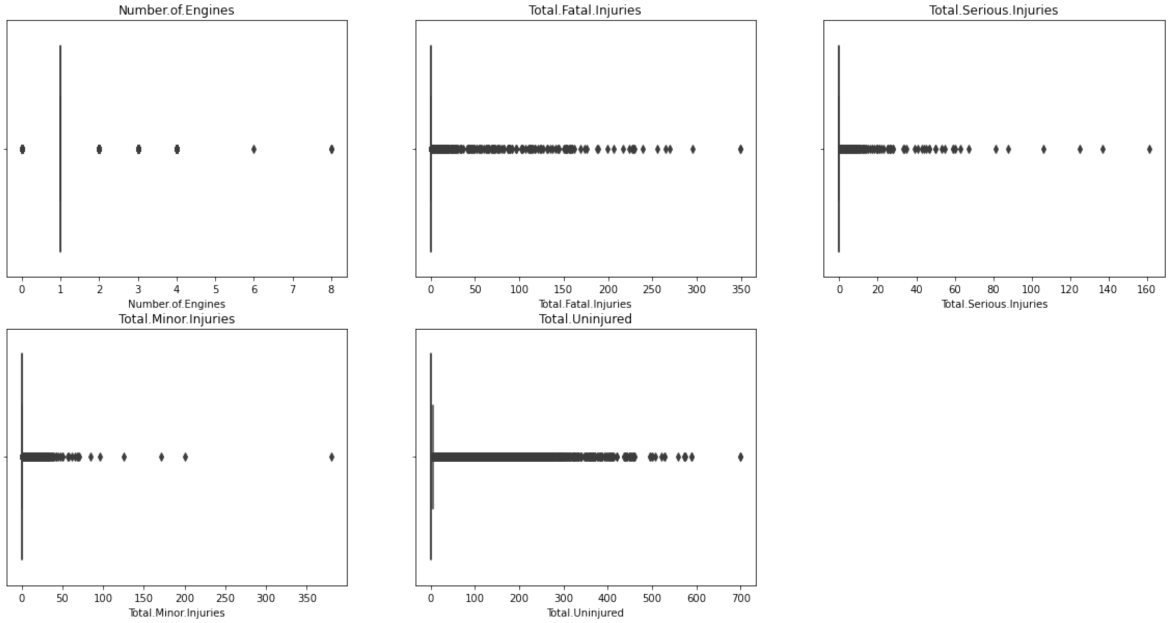
In [44]:
```
#Drop the duplicates
df = df.drop_duplicates()

#Confirm the duplicated rows are removed
df.duplicated().sum().any()
```

Out[44]:
```
False
```

In [46]:
```
#Showing the shape of the dataset
df.shape
```

Out[46]:
```
(88854, 18)
```

In [47]:
```
#Checking outliers
#First select numerical columns
numerical_columns = ["Number.of.Engines", "Total.Fatal.Injuries", "Total.Seri
#Plot boxplots for each numerical column
plt.figure(figsize=(20, 10))
for i, column in enumerate(numerical_columns, 1):
    plt.subplot(2, 3, i,)
    sns.boxplot(x=df[column])
    plt.title(column);
```



In [48]:
```
#Saving the clean dataset
df.to_csv("Clean_Aviation_Data.csv", index=False)
```

In [49]:
```
#Reading the new data
data = pd.read_csv("Clean_Aviation_Data.csv")
data.head()
```

Out[49]:

	Event.Date	Location	Country	Injury.Severity	Aircraft.damage	Aircraft.Category	Make	M
0	1948-10-24	moose creek, id	united states	fatal(2)	destroyed	unknown	stinson	
1	1962-07-19	bridgeport, ca	united states	fatal(4)	destroyed	unknown	piper	
2	1974-08-30	saltville, va	united states	fatal(3)	destroyed	unknown	cessna	
3	1977-06-19	eureka, ca	united states	fatal(2)	destroyed	unknown	rockwell	
4	1979-08-02	canton, oh	united states	fatal(1)	destroyed	unknown	cessna	

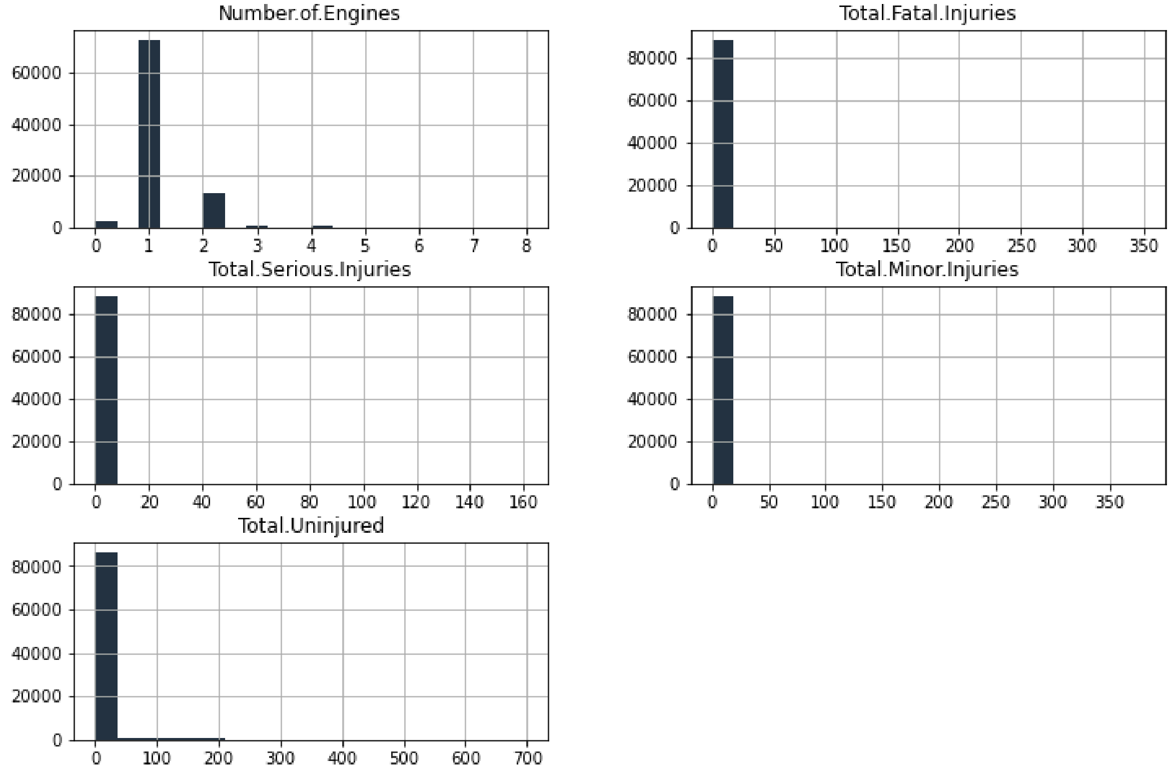
In [50]:
```
#Copying the new data
data1 = data.copy(deep=True)
```

UNIVARIATE ANALYSIS

In [51]:
```
# Summary statistics for numerical columns
print(df.describe())
```

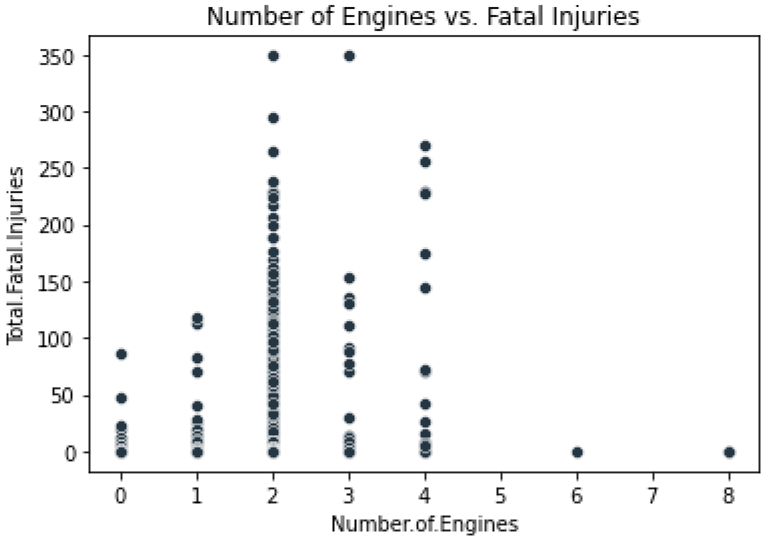
```
       Number.of.Engines  Total.Fatal.Injuries  Total.Serious.Injuries  \
count       88854.000000          88854.000000            88854.000000   
mean            1.146487              0.564724                0.240507   
std             0.465134              5.127606                1.434820   
min             0.000000              0.000000                0.000000   
25%             1.000000              0.000000                0.000000   
50%             1.000000              0.000000                0.000000   
75%             1.000000              0.000000                0.000000   
max             8.000000            349.000000              161.000000   

       Total.Minor.Injuries  Total.Uninjured  
count          88854.000000     88854.000000  
mean               0.309136         4.964549  
std                2.083992        26.980768  
min                0.000000         0.000000  
25%                0.000000         0.000000  
50%                0.000000         1.000000  
75%                0.000000         2.000000  
max              380.000000       699.000000  
```

In [52]:
```
# Histogram for numerical columns
numerical_columns = ["Number.of.Engines", "Total.Fatal.Injuries", "Total.Seri
data1[numerical_columns].hist(figsize=(12, 8), bins=20, color="#243642");
```



BIVARIATE ANALYSIS

In [53]:
```
# Scatter plot showing the relation between the number of engines and the tota
sns.scatterplot(x="Number.of.Engines", y="Total.Fatal.Injuries", data=data1, 
plt.title("Number of Engines vs. Fatal Injuries");
```

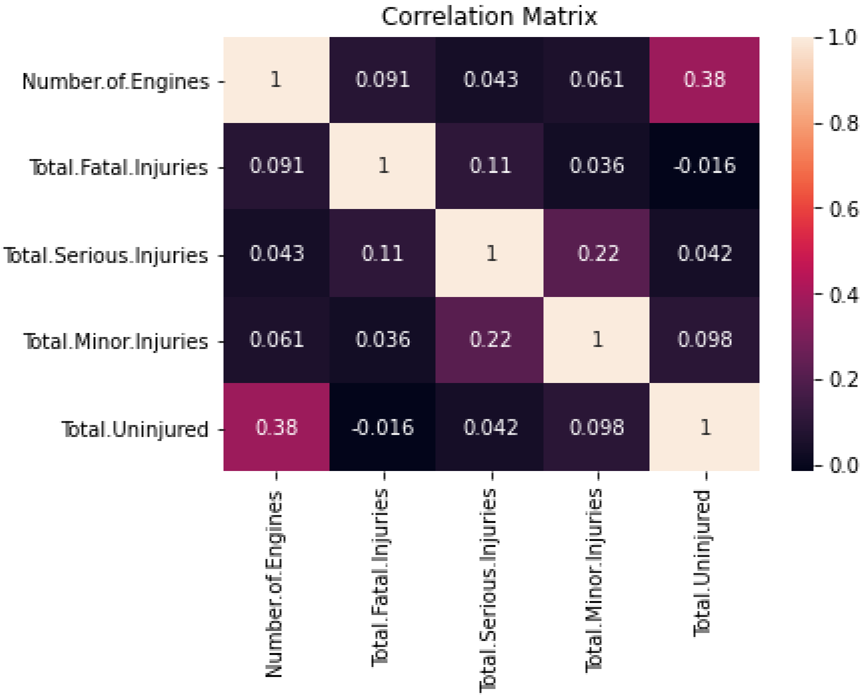


Conclusion

- This shows that Aircrafts with 0, 2 and 4 engines have recorded the highest number of fatal injuries.
- Aircrafts with 1 and 3 engines have few numbers of fatal injuries.
- Aircrafts with 6 and 8 engines have zero fatal injuries meaning they are safe.

In [54]:

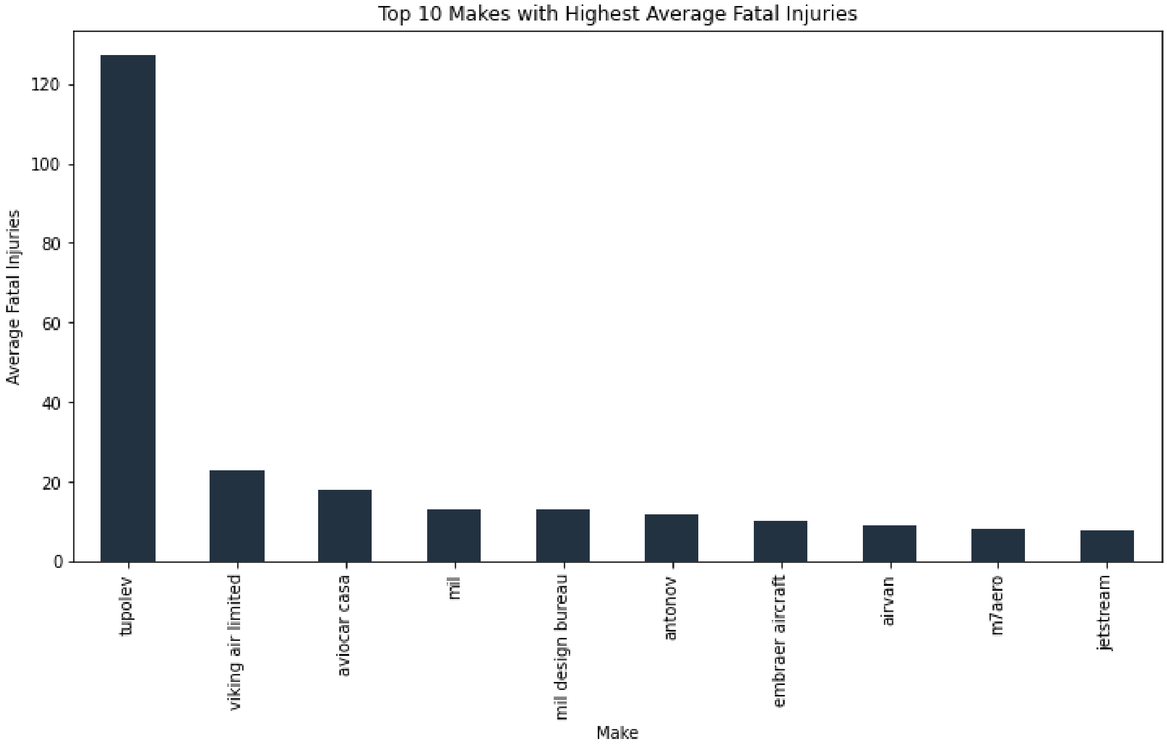
```
# Correlation matrix of number of engines to the total injuries
corr_matrix = data1[numerical_columns].corr()
sns.heatmap(corr_matrix, annot=True, color="#243642")
plt.title('Correlation Matrix');
```



- The matrix suggests that the number of engines has a modest positive relationship with the number of uninjured individuals, implying that multi-engine aircraft might provide better safety outcomes.
- However, the number of engines does not significantly correlate with the likelihood or severity of injuries.

In [55]:

```
#A bar plot to show the top 10 makes with the highest average fatal injuries
avg_fatalities_by_make = data1.groupby("Make")["Total.Fatal.Injuries"].mean()
avg_fatalities_by_make[:10].plot(kind="bar", figsize=(12, 6), color="#243642"
plt.title("Top 10 Makes with Highest Average Fatal Injuries")
plt.ylabel("Average Fatal Injuries");
```



In [56]:

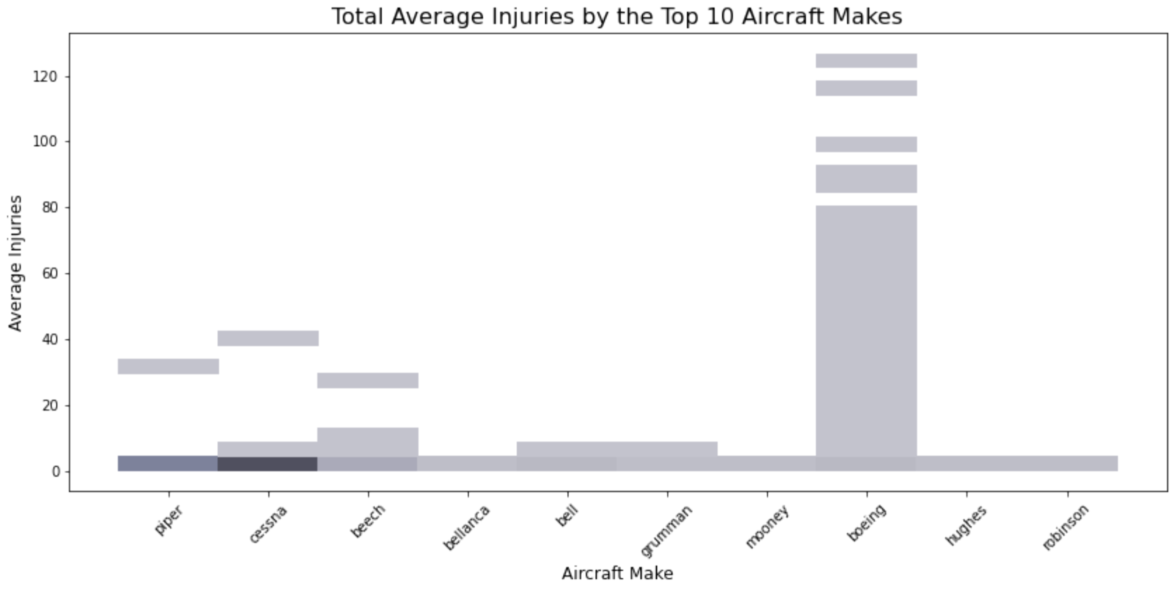
```
data1.columns
```

Out[56]:

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

In [57]:

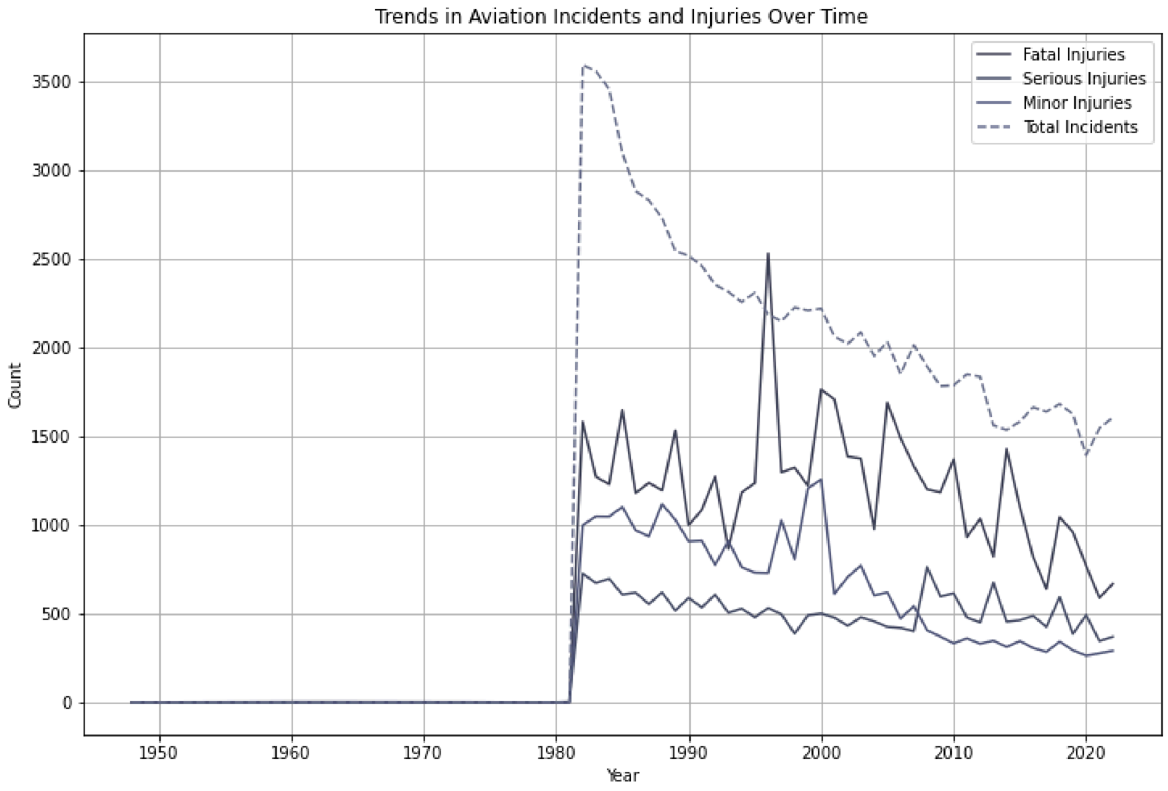
```
# Calculate the average of the three injury columns for each row
average_injuries = ((data1["Total.Fatal.Injuries"] + data1["Total.Serious.Inj

# Take the top 10 makes by count for faster plotting
top_makes = data1["Make"].value_counts().head(10).index
subset_data = data1[data1["Make"].isin(top_makes)]

# Calculate the average injuries for the subset
average_injuries_subset = ((subset_data["Total.Fatal.Injuries"] + subset_data

# Plotting the histogram with a smaller dataset
plt.figure(figsize=(14, 6))
sns.histplot( x=subset_data["Make"], y=average_injuries_subset, bins=30, kde=

# Rotate x-axis labels for readability
plt.xticks(rotation=45, fontsize=10)

plt.title("Total Average Injuries by the Top 10 Aircraft Makes", fontsize=16)
plt.xlabel("Aircraft Make", fontsize=12)
plt.ylabel("Average Injuries", fontsize=12);
```



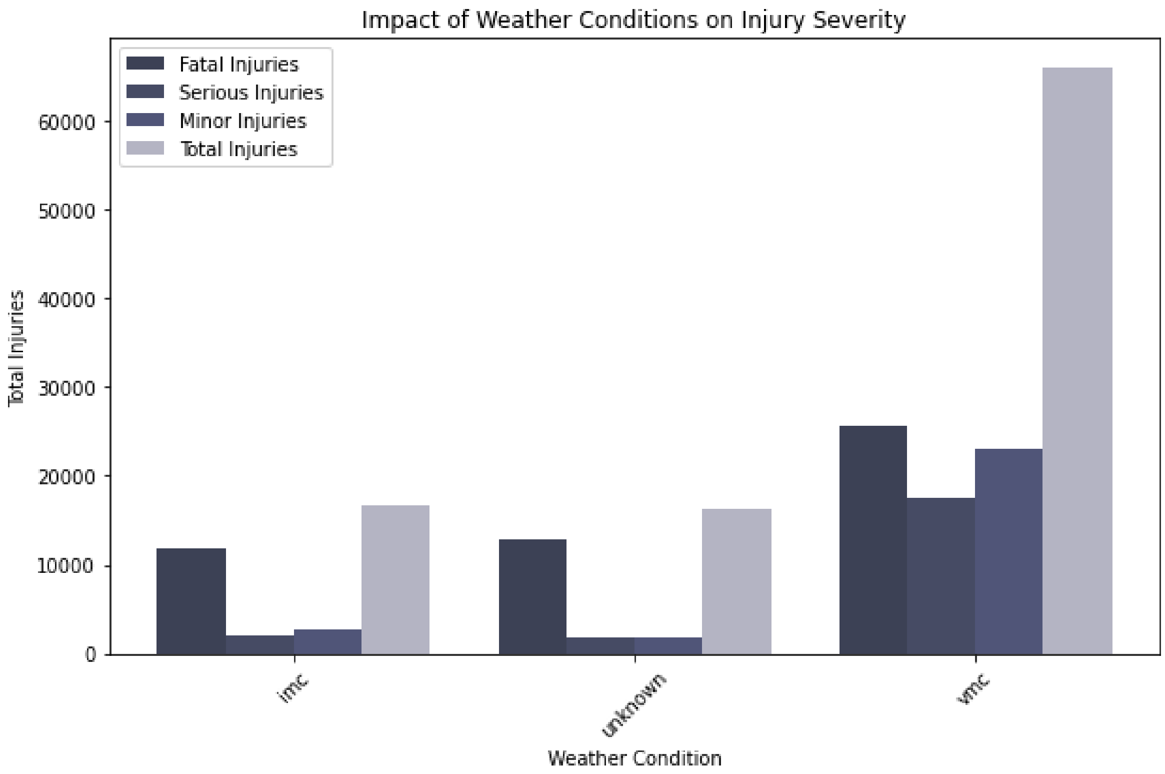
- The chart reveals that Boeing has the highest average injuries among the top 10 aircraft manufacturers, far surpassing others.

In [58]:

```
#Convert 'Event.Date' to datetime for time trend analysis
data1["Event.Date"] = pd.to_datetime(data1["Event.Date"], errors="coerce")

#Extract the year from the date for aggregation
data1["Year"] = data1["Event.Date"].dt.year

#Group data by year and calculate the total injuries (fatal, serious, minor) a
time_trends = data1.groupby("Year").agg({"Total.Fatal.Injuries": "sum", "Tota

#Remove rows with null years or zero incidents for better analysis
time_trends = time_trends[time_trends["Year"].notnull() & (time_trends["Total

#Plot the trends
plt.figure(figsize=(12, 8))
plt.plot(time_trends["Year"], time_trends["Total.Fatal.Injuries"], label="Fata
plt.plot(time_trends["Year"], time_trends["Total.Serious.Injuries"], label="Se
plt.plot(time_trends["Year"], time_trends["Total.Minor.Injuries"], label="Mino
plt.plot(time_trends["Year"], time_trends["Total.Incidents"], label="Total Inc

plt.title("Trends in Aviation Incidents and Injuries Over Time")
plt.xlabel("Year")
plt.ylabel("Count")
plt.legend()
plt.grid(True);
```



In [59]:
```
# Group the data by Weather.Condition and sum the injuries for each condition
weather_injury_analysis = data1.groupby("Weather.Condition").agg({"Total.Fata

# Create a new column for total injuries
weather_injury_analysis["Total.Injuries"] = (weather_injury_analysis["Total.F

# Plotting the impact of weather conditions on injury severity
plt.figure(figsize=(10, 6))

# Plot each type of injury as bars
bar_width = 0.2
index = range(len(weather_injury_analysis))

# Plot Fatal, Serious, Minor, and Total Injuries for each weather condition
plt.bar(index, weather_injury_analysis["Total.Fatal.Injuries"], width=bar_wid
plt.bar([i + bar_width for i in index], weather_injury_analysis["Total.Seriou
plt.bar([i + 2 * bar_width for i in index], weather_injury_analysis["Total.Mi
plt.bar([i + 3 * bar_width for i in index], weather_injury_analysis["Total.In

# Customize the plot
plt.title("Impact of Weather Conditions on Injury Severity")
plt.xlabel("Weather Condition")
plt.ylabel("Total Injuries")
plt.xticks([i + 1.5 * bar_width for i in index], weather_injury_analysis["Wea
plt.legend();
```



- This shows us that most accidents happenned during vmc(Visual Meteorological Conditions) whereby the weather was condusive.

[illegible]