Final Project Submission

Please fill out:

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- Student pace: part time
- Scheduled project review date/time:
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- Blog post URL:

AVIATION DATA PROJECT

Business Overview; Content: Business Problem: The company is evaluating risks in the aviation industry to determine the safest aircraft and operational conditions. Dataset: Aviation accident data from 1962–2023. Goal: Recommend aircraft types and safety measures based on data analysis.

Business Understanding

Stakeholder Needs: The aviation division head requires actionable insights to minimize risk when selecting aircraft for operations. Insights must address safety, reliability, and potential hazards associated with specific aircraft types, flight conditions, or operational factors.

Statement of the Problem The company seeks to:

i)Identify low-risk aircraft for purchase. ii)Understand trends in aviation accidents and incidents. iii)Develop recommendations based on accident frequency, severity, and contributing factors.

Approach:

1. Data Analysis;

i)Investigate trends in accident frequency over time. ii)Examine relationships between aircraft specifications and safety records. iii)Assess the impact of external factors (e.g., weather, flight purpose) on safety outcomes.

outcome ... Content: . Weather conditions strongly correlate with higher fatalities, especially adverse conditions like storms or fog. . The landing and takeoff phases have the most accidents. . A general decline in fatalities is observed after the year 2000, potentially due to better technology and regulations

1. Data Cleaning

. Removed irrelevant columns (e.g., redundant identifiers, report status). . Addressed missing values by imputing or replacing them with median values or 'Unknown'. . Extracted key insights from cleaned data.

1. Visualization

Use visual storytelling (e.g., bar charts, heatmaps) to highlight findings.

Include the four charts: Fatalities by Weather Condition (Bar Chart) Fatalities by Phase of Flight (Bar Chart) Fatalities Over weather conditions(bar chart) Injury Severity Distribution (Pie Chart)

1. Recommendations . Purchase aircraft models with low fatality and injury records. . Invest in aircraft with advanced weather-handling technology. . Enhance safety protocols during takeoff and landing.

1. Next Steps . Conduct a deeper dive into manufacturer reliability and maintenance logs. . Incorporate external datasets for a comprehensive risk analysis. . Use predictive modeling to forecast risk levels.

1. Thank You Content: Thank you for your time. feel free to ask any questions. Share your contact details: Name: Murugi Nguru | LinkedIn: [Your LinkedIn Profile]

In [2]:

```
#1. Inspect the Dataset
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [3]:

```
aviation_data = pd.read_csv('data/Aviation_Data.csv')
```

```
C:\Users\Murugi\Anaconda3\envs\learn-env\lib\site-packages\IPython\core\interactivesh
ell.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,
```

In [58]:

```
# Display basic info and first rows
print(aviation_data.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 90348 entries, 0 to 90347
Data columns (total 31 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   Event.Id                88889 non-null  object
 1   Investigation.Type      90348 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            50249 non-null  object
 9   Airport.Name            52790 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     87572 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             81812 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           82508 non-null  object
 30  Publication.Date        73659 non-null  object
dtypes: float64(5), object(26)
memory usage: 21.4+ MB
None
```

In [4]:

```
print(aviation_data.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  36.9222  -81.8781          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]
```

In [5]:

```
print(aviation_data.describe())
```

```
       Number.of.Engines  Total.Fatal.Injuries  Total.Serious.Injuries  \
count       82805.000000          77488.000000            76379.000000
mean            1.146585              0.647855                0.279881
std             0.446510              5.485960                1.544084
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          76956.000000     82977.000000
mean               0.357061         5.325440
std                2.235625        27.913634
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
```

1. Handle Missing Values Inspect missing values:

In [6]:

```
# Percentage of missing values
missing_values = (aviation_data.isnull().sum() / len(aviation_data)) * 100
print(missing_values.sort_values(ascending=False))
```

```
Schedule                  86.073848
Air.carrier               81.573471
FAR.Description           64.555939
Aircraft.Category         64.263736
Longitude                 61.954886
Latitude                  61.944924
Airport.Code              44.382831
Airport.Name              41.570372
Broad.phase.of.flight     31.681941
Publication.Date          18.471909
Total.Serious.Injuries    15.461327
Total.Minor.Injuries      14.822686
Total.Fatal.Injuries      14.233851
Engine.Type                9.447913
Report.Status              8.677558
Purpose.of.flight          8.468367
Number.of.Engines          8.348829
Total.Uninjured            8.158454
Weather.Condition          6.586753
Aircraft.damage            5.150086
Registration.Number        3.072564
Injury.Severity            2.721698
Country                    1.865011
Amateur.Built              1.727764
Model                      1.716695
Make                       1.684597
Location                   1.672422
Event.Date                 1.614867
Accident.Number            1.614867
Event.Id                   1.614867
Investigation.Type         0.000000
dtype: float64
```

drop columns with >40% missing data;

In [7]:

```
print(aviation_data.columns)
```

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

In [8]:

```
aviation_data.columns = aviation_data.columns.str.strip()
```

In [9]:

```
columns_to_drop = [
    'Event.Id', 'Accident.Number', 'Registration.Number',
    'Report.Status', 'Publication.Date'
]

# Only drop columns that exist in the dataset
aviation_data = aviation_data.drop(
    columns=[col for col in columns_to_drop if col in aviation_data.columns],
    axis=1
)
```

In [10]:

```
print(aviation_data.head())
```

```
  Investigation.Type  Event.Date         Location        Country Latitude  \
0           Accident  1948-10-24  MOOSE CREEK, ID  United States      NaN
1           Accident  1962-07-19   BRIDGEPORT, CA  United States      NaN
2           Accident  1974-08-30    Saltville, VA  United States  36.9222
3           Accident  1977-06-19       EUREKA, CA  United States      NaN
4           Accident  1979-08-02       Canton, OH  United States      NaN

  Longitude Airport.Code Airport.Name Injury.Severity Aircraft.damage  ...  \
0       NaN          NaN          NaN        Fatal(2)       Destroyed  ...
1       NaN          NaN          NaN        Fatal(4)       Destroyed  ...
2  -81.8781          NaN          NaN        Fatal(3)       Destroyed  ...
3       NaN          NaN          NaN        Fatal(2)       Destroyed  ...
4       NaN          NaN          NaN        Fatal(1)       Destroyed  ...

  FAR.Description Schedule Purpose.of.flight Air.carrier  \
0             NaN      NaN          Personal         NaN
1             NaN      NaN          Personal         NaN
2             NaN      NaN          Personal         NaN
3             NaN      NaN          Personal         NaN
4             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
0             0.0               UNK                Cruise
1             0.0               UNK               Unknown
2             NaN               IMC                Cruise
3             0.0               IMC                Cruise
4             0.0               VMC              Approach

[5 rows x 26 columns]
```

In [ ]:

In [11]:

```
# Fill numeric columns with median
aviation_data['Total.Fatal.Injuries'] = aviation_data['Total.Fatal.Injuries'].fillna
aviation_data['Total.Serious.Injuries'] = aviation_data['Total.Serious.Injuries'].fi

# Fill categorical columns with 'Unknown'
aviation_data['Weather.Condition'] = aviation_data['Weather.Condition'].fillna('Unkn
aviation_data['Broad.phase.of.flight'] = aviation_data['Broad.phase.of.flight'].fill
```

In [12]:

```
print(aviation_data.isnull().sum())
```

```
Investigation.Type            0
Event.Date                 1459
Location                   1511
Country                    1685
Latitude                  55966
Longitude                 55975
Airport.Code              40099
Airport.Name              37558
Injury.Severity            2459
Aircraft.damage            4653
Aircraft.Category         58061
Make                       1522
Model                      1551
Amateur.Built              1561
Number.of.Engines          7543
Engine.Type                8536
```

```
FAR.Description          58325
Schedule                 77766
Purpose.of.flight         7651
Air.carrier              73700
Total.Fatal.Injuries         0
Total.Serious.Injuries       0
Total.Minor.Injuries     13392
Total.Uninjured           7371
Weather.Condition            0
Broad.phase.of.flight        0
dtype: int64
```

In [13]:

```
aviation_data = aviation_data.drop(columns=['Number.of.Engines', 'Engine.Type', 'Pur
```

In [14]:

```
# Fill categorical columns with the mode (most frequent value)
aviation_data['Location'] = aviation_data['Location'].fillna(aviation_data['Location
aviation_data['Country'] = aviation_data['Country'].fillna(aviation_data['Country'].
aviation_data['Injury.Severity'] = aviation_data['Injury.Severity'].fillna(aviation_
aviation_data['Aircraft.damage'] = aviation_data['Aircraft.damage'].fillna(aviation_
aviation_data['Make'] = aviation_data['Make'].fillna(aviation_data['Make'].mode()[0]
aviation_data['Model'] = aviation_data['Model'].fillna(aviation_data['Model'].mode()
aviation_data['Amateur.Built'] = aviation_data['Amateur.Built'].fillna(aviation_data

# Fill numeric columns with the median
aviation_data['Total.Minor.Injuries'] = aviation_data['Total.Minor.Injuries'].fillna
aviation_data['Total.Uninjured'] = aviation_data['Total.Uninjured'].fillna(aviation_
```

In [15]:

```
print(aviation_data.isnull().sum())
```

```
Investigation.Type           0
Event.Date                1459
Location                     0
Country                      0
Latitude                 55966
Longitude                55975
Airport.Code             40099
Airport.Name             37558
Injury.Severity              0
Aircraft.damage              0
Aircraft.Category        58061
Make                         0
Model                        0
Amateur.Built                0
FAR.Description          58325
Schedule                 77766
Air.carrier              73700
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 [16]:

```
aviation_data = aviation_data.dropna(subset=['Event.Date'])
```

Step 3: Verify Cleaned Data

In [17]:

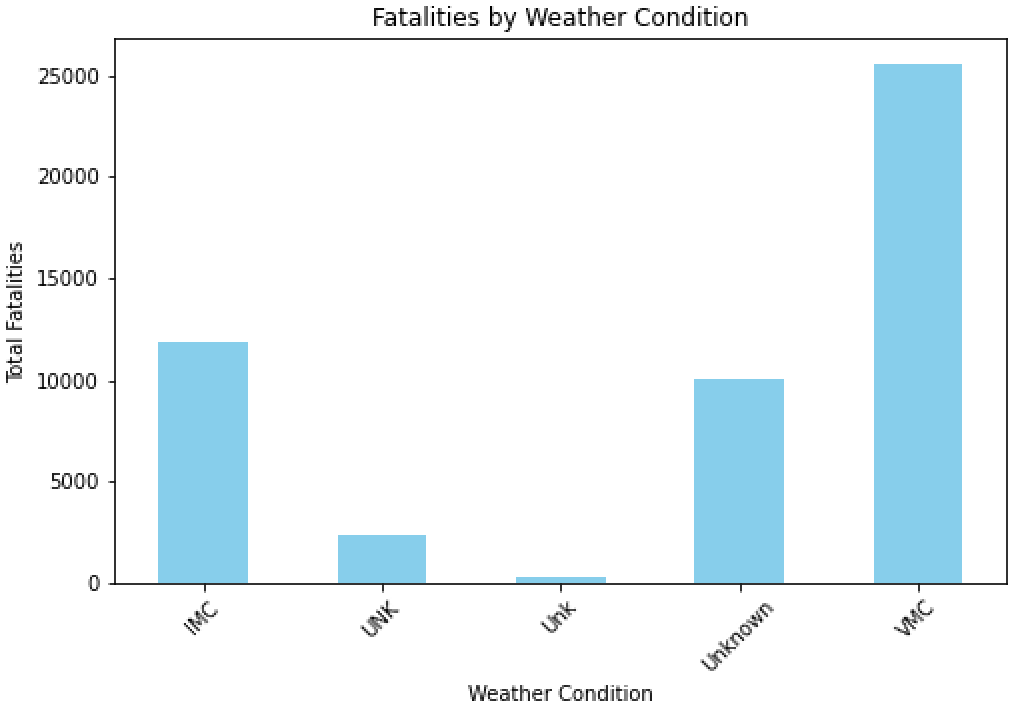
```
print(aviation_data.isnull().sum())
```

```
Investigation.Type           0
Event.Date                   0
Location                     0
Country                      0
Latitude                 54507
Longitude                54516
Airport.Code             38640
Airport.Name              36099
Injury.Severity               0
Aircraft.damage               0
Aircraft.Category         56602
Make                          0
Model                         0
Amateur.Built                 0
FAR.Description           56866
Schedule                  76307
Air.carrier               72241
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
```

1. Fatalities by Weather Condition Objective: Show how fatalities vary under different weather conditions. Visualization Type: Bar Chart

In [18]:

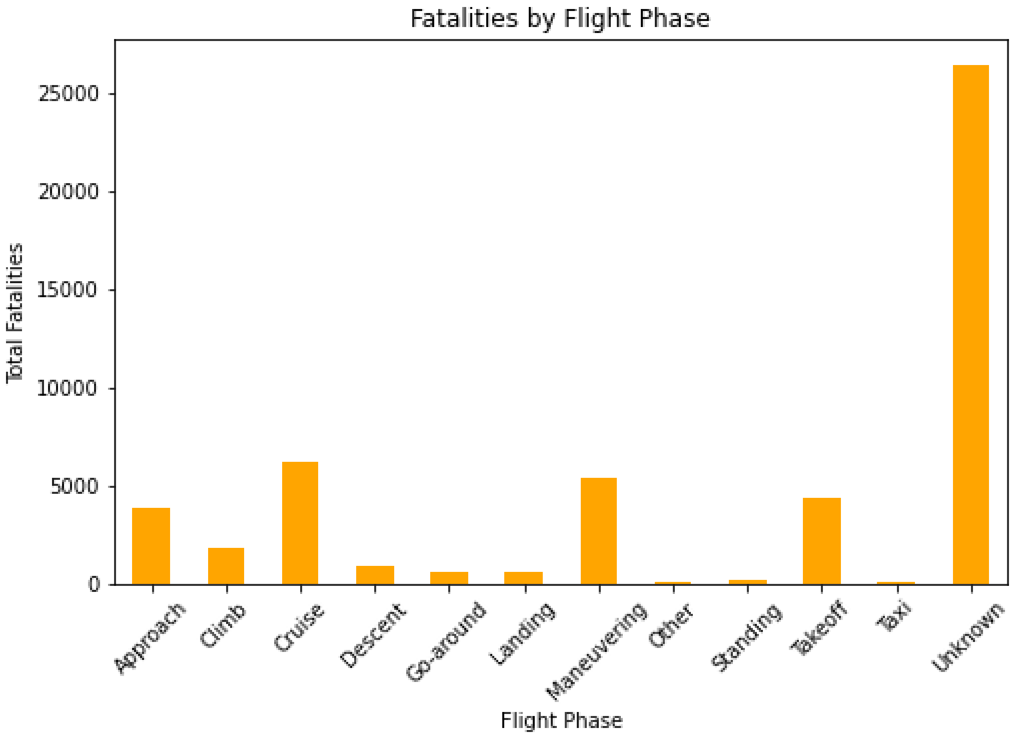
```
fatalities_weather = aviation_data.groupby('Weather.Condition')['Total.Fatal.Injurie
fatalities_weather.plot(kind='bar', color='skyblue', title='Fatalities by Weather Co
plt.xticks(rotation=45)
plt.show()
```



1. Fatalities by Phase of Flight Objective: Identify which flight phases are the riskiest. Visualization Type: Bar Chart

In [19]:

```
fatalities_phase = aviation_data.groupby('Broad.phase.of.flight')['Total.Fatal.Injur
fatalities_phase.plot(kind='bar', color='orange', title='Fatalities by Flight Phase'
plt.xticks(rotation=45)
plt.show()
```



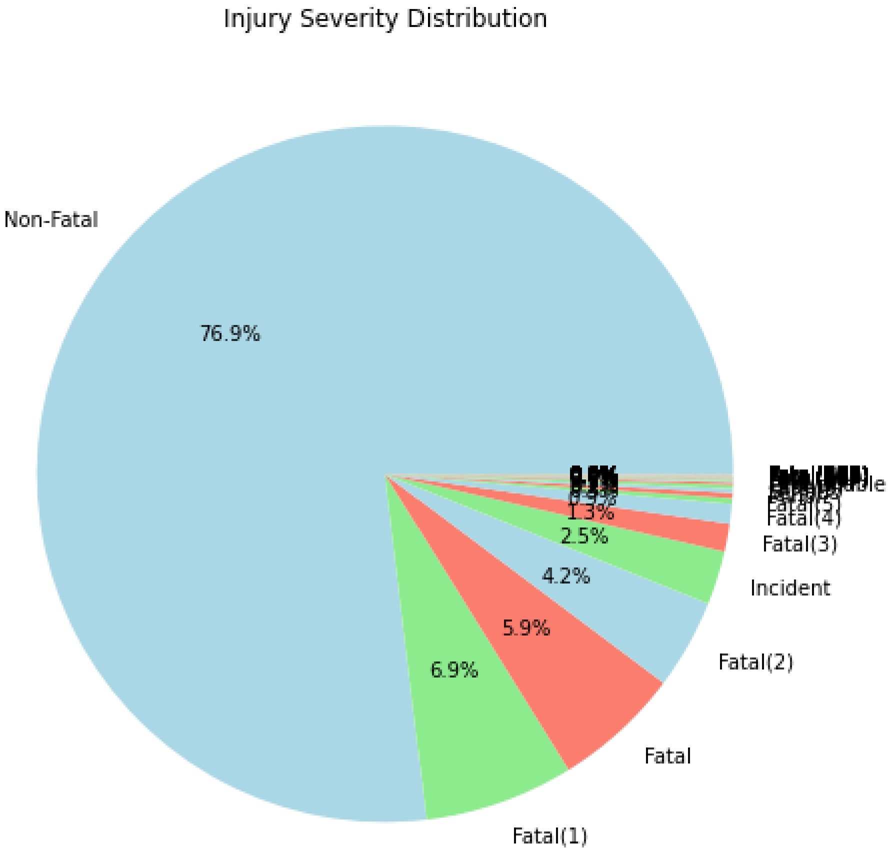
In [79]:
```
print(aviation_data.columns)
```

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

In [ ]:

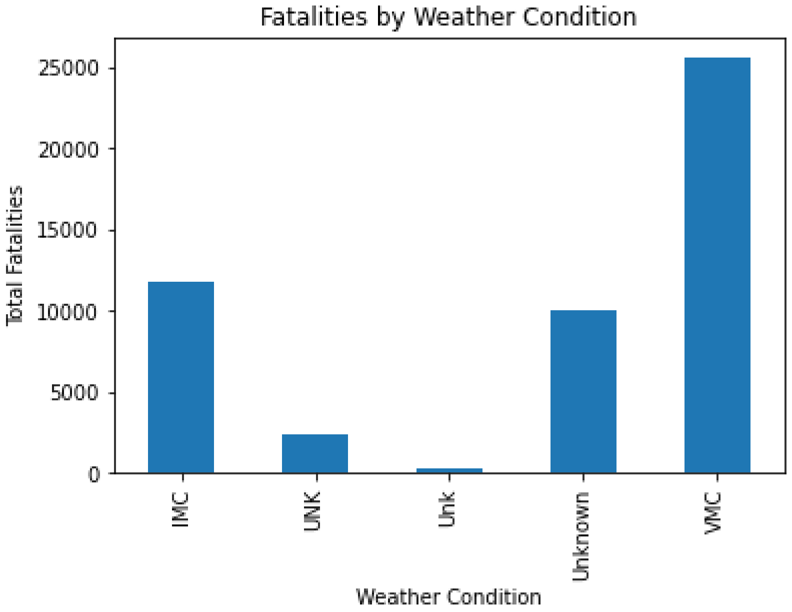
1. Injury Severity Distribution Objective: Highlight the distribution of injury severity across all accidents. Visualization Type: Pie Chart

In [22]:
```
injury_severity = aviation_data['Injury.Severity'].value_counts()
injury_severity.plot(kind='pie', autopct='%1.1f%%', colors=['lightblue', 'lightgreen
plt.ylabel('')
plt.show()
```



```
In [80]: fatality_analysis = aviation_data.groupby('Weather.Condition')['Total.Fatal.Injuries
         fatality_analysis.plot(kind='bar', title='Fatalities by Weather Condition', xlabel='
```

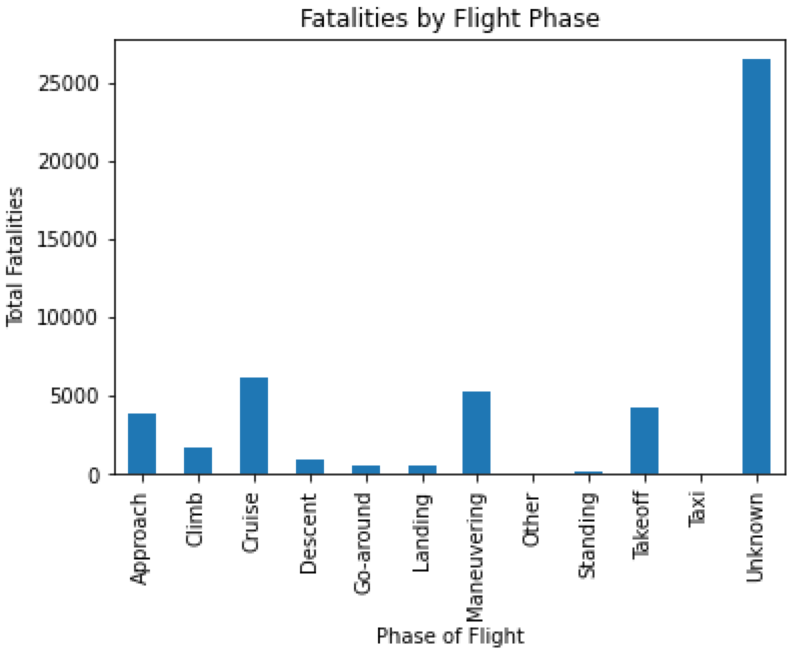
```
Out[80]: <AxesSubplot:title={'center':'Fatalities by Weather Condition'}, xlabel='Weather Cond
         ition', ylabel='Total Fatalities'>
```



use Broad.phase.of.flight to analyze fatalities during different phases of flight:

```
In [81]: fatality_analysis = aviation_data.groupby('Broad.phase.of.flight')['Total.Fatal.Inju
         fatality_analysis.plot(kind='bar', title='Fatalities by Flight Phase', xlabel='Phase
```

```
Out[81]: <AxesSubplot:title={'center':'Fatalities by Flight Phase'}, xlabel='Phase of Flight',
         ylabel='Total Fatalities'>
```


Fatalities by Flight Phase
Total Fatalities
25000
20000
15000
10000
5000
0
Approach
Climb
Cruise
Descent
Go-around
Landing
Maneuvering
Other
Standing
Takeoff
Taxi
Unknown
Phase of Flight

```
In [ ]:
```