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Phase1-Project

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Phase1-Project / Jupyter Notebook.ipynb

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1256 lines (1256 loc) · 94.5 KB

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Project Overview: Assessing Aircraft Risk for New Aviation Division

Business problem

Your company is expanding in to new industries to diversify its portfolio. Specifically, they are interested in purchasing and operating airplanes for commercial and private enterprises, but do not know anything about the potential risks of aircraft. You are charged with determining which aircraft are the lowest risk for the company to start this new business endeavor. You must then translate your findings into actionable insights that the head of the new aviation division can use to help decide which aircraft to purchase.

The Data

The data is from the National Transportation Safety Board that includes aviation accident data from 1962 to 2023 about civil aviation accidents and selected incidents in the United States and international waters.

Goals

To identify which aircrafts are the lowest risk for the company.

Technical Presentation.

In [5]:
```
#Importing Libraries.
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [6]:
```
#Importing the dataset
df = pd.read_csv('AviationData.csv', encoding='latin-1')
```

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

Data Exploration.

In [7]:
```
#Explore the first rows
df.head()
```

Out[7]:

	Event.Id	Investigation.Type	Accident.Number	Event.Date	Locatior

0	20001218X45444	Accident	SEA87LA080	1948-10-24	MOOSE CREEK, I
1	20001218X45447	Accident	LAX94LA336	1962-07-19	BRIDGEPORT C
2	20061025X01555	Accident	NYC07LA005	1974-08-30	Saltville, V
3	20001218X45448	Accident	LAX96LA321	1977-06-19	EUREKA, C
4	20041105X01764	Accident	CHI79FA064	1979-08-02	Canton, O

5 rows × 31 columns

In [8]:
```python
#Checking its shape
df.shape
```

Out[8]:
```
(88889, 31)
```

In [9]:
```python
#Checking the columns
df.columns
```

Out[9]:
```
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.Descripti
on',
       'Schedule', 'Purpose.of.flight', 'Air.carrier', 'Total.Fatal.Injuri
es',
       'Total.Serious.Injuries', 'Total.Minor.Injuries', 'Total.Uninjure
d',
       'Weather.Condition', 'Broad.phase.of.flight', 'Report.Status',
       'Publication.Date'],
      dtype='object')
```

In [10]:
```python
df.info
```

Out[10]:
```
<bound method DataFrame.info of               Event.Id Investigation.Type A
ccident.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
...               ...                ...             ...         ...
88884  20221227106491           Accident      ERA23LA093  2022-12-26
88885  20221227106494           Accident      ERA23LA095  2022-12-26
88886  20221227106497           Accident      WPR23LA075  2022-12-26
88887  20221227106498           Accident      WPR23LA076  2022-12-26
88888  20221230106513           Accident      ERA23LA097  2022-12-29

              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
...               ...            ...      ...       ...          ...
88884    Annapolis, MD  United States      NaN       NaN          NaN
88885      Hampton, NH  United States      NaN       NaN          NaN
88886       Payson, AZ  United States  341525N  1112021W          PAN
88887       Morgan, UT  United States      NaN       NaN          NaN
88888       Athens, GA  United States      NaN       NaN          NaN

      Airport.Name  ... Purpose.of.flight        Air.carrier  \
0              NaN  ...          Personal                NaN
1              NaN  ...          Personal                NaN
2              NaN  ...          Personal                NaN
3              NaN  ...          Personal                NaN
4              NaN  ...          Personal                NaN
...            ...  ...               ...                ...
88884          NaN  ...          Personal                NaN
88885          NaN  ...               NaN                NaN
88886       PAYSON  ...          Personal                NaN
88887          NaN  ...          Personal  MC CESSNA 210N LLC
88888          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  \
0                 0.0               UNK                 Cruise
1                 0.0               UNK                Unknown
2                 NaN               IMC                 Cruise
3                 0.0               IMC                 Cruise
4                 0.0               VMC               Approach
...               ...               ...                    ...
88884             0.0               NaN                    NaN
88885             0.0               NaN                    NaN
88886             1.0               VMC                    NaN
88887             0.0               NaN                    NaN
88888             1.0               NaN                    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
...               ...              ...
88884             NaN       29-12-2022
88885             NaN              NaN
88886             NaN       27-12-2022
88887             NaN              NaN
88888             NaN       30-12-2022

[88889 rows x 31 columns]>
```

In [11]:

```
df.describe
```

Out[11]:

```
<bound method NDFrame.describe of              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
...               ...                ...             ...         ...
88884  20221227106491           Accident      ERA23LA093  2022-12-26
88885  20221227106494           Accident      ERA23LA095  2022-12-26
88886  20221227106497           Accident      WPR23LA075  2022-12-26
88887  20221227106498           Accident      WPR23LA076  2022-12-26
88888  20221230106513           Accident      ERA23LA097  2022-12-29

              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
...                ...            ...      ...       ...          ...
88884    Annapolis, MD  United States      NaN       NaN          NaN
88885      Hampton, NH  United States      NaN       NaN          NaN
88886       Payson, AZ  United States  341525N  1112021W          PAN
88887       Morgan, UT  United States      NaN       NaN          NaN
88888       Athens, GA  United States      NaN       NaN          NaN

      Airport.Name  ... Purpose.of.flight        Air.carrier  \
0              NaN  ...          Personal                NaN
1              NaN  ...          Personal                NaN
2              NaN  ...          Personal                NaN
3              NaN  ...          Personal                NaN
4              NaN  ...          Personal                NaN
...            ...  ...               ...                ...
88884          NaN  ...          Personal                NaN
88885          NaN  ...               NaN                NaN
88886       PAYSON  ...          Personal                NaN
88887          NaN  ...          Personal  MC CESSNA 210N LLC
88888          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  \
0                 0.0               UNK                 Cruise
1                 0.0               UNK                Unknown
2                 NaN               IMC                 Cruise
3                 0.0               IMC                 Cruise
4                 0.0               VMC               Approach
...               ...               ...                    ...
88884             0.0               NaN                    NaN
88885             0.0               NaN                    NaN
```

```
88886            1.0              VMC                 NaN
88887            0.0              NaN                 NaN
88888            1.0              NaN                 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
...               ...              ...
88884             NaN       29-12-2022
88885             NaN              NaN
88886             NaN       27-12-2022
88887             NaN              NaN
88888             NaN       30-12-2022

[88889 rows x 31 columns]>
```

Data Cleaning

From the above findings we can see the dataset has some null values. We are going to clean the data inorder to get a better understanding of the data.

In [12]:
```
#Checking for Null values
df.isnull().sum()
```

Out[12]:
```
Event.Id                      0
Investigation.Type            0
Accident.Number               0
Event.Date                    0
Location                     52
Country                     226
Latitude                  54507
Longitude                 54516
Airport.Code              38640
Airport.Name              36099
Injury.Severity            1000
Aircraft.damage            3194
Aircraft.Category         56602
Registration.Number        1317
Make                         63
Model                        92
Amateur.Built               102
Number.of.Engines          6084
Engine.Type                7077
FAR.Description           56866
Schedule                  76307
Purpose.of.flight          6192
Air.carrier               72241
Total.Fatal.Injuries      11401
Total.Serious.Injuries    12510
Total.Minor.Injuries      11933
Total.Uninjured            5912
Weather.Condition          4492
Broad.phase.of.flight     27165
Report.Status              6381
Publication.Date          13771
dtype: int64
```

In [13]:
```
#Drop columns that have more missing values
thershold = len(df) * 0.5
```

```
df = df.dropna(thresh=thershold, axis=1)
df.shape
```

Out[13]:

```
(88889, 25)
```

In [14]:

```
#Finding more Null Values
df.isnull().sum()
```

Out[14]:

```
Event.Id                      0
Investigation.Type            0
Accident.Number               0
Event.Date                    0
Location                     52
Country                     226
Airport.Code              38640
Airport.Name              36099
Injury.Severity            1000
Aircraft.damage            3194
Registration.Number        1317
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
Report.Status              6381
Publication.Date          13771
dtype: int64
```

In [15]:

```
#Checking the difference of the remaining values
d={}
for i in df.columns:
    d[i]=len(df[i].unique())
unique_values= pd.DataFrame(list(d.items()), columns=['Column', 'unique_va
unique_values["missing_values"]= df.isna().sum().values
unique_values
```

Out[15]:

	Column	unique_val	missing_values
0	Event.Id	87951	0
1	Investigation.Type	2	0
2	Accident.Number	88863	0
3	Event.Date	14782	0
4	Location	27759	52
5	Country	220	226
6	Airport.Code	10376	38640
7	Airport.Name	24872	36099

8	Injury.Severity	110	1000
9	Aircraft.damage	5	3194
10	Registration.Number	79106	1317
11	Make	8238	63
12	Model	12319	92
13	Amateur.Built	3	102
14	Number.of.Engines	8	6084
15	Engine.Type	14	7077
16	Purpose.of.flight	27	6192
17	Total.Fatal.Injuries	126	11401
18	Total.Serious.Injuries	51	12510
19	Total.Minor.Injuries	58	11933
20	Total.Uninjured	380	5912
21	Weather.Condition	5	4492
22	Broad.phase.of.flight	13	27165
23	Report.Status	17076	6381
24	Publication.Date	2925	13771

In [16]:

```
#Dropping columns with more missing values
subset_col=list(unique_values[unique_values['missing_values']>1000]['Colum
df.dropna(subset=subset_col, inplace=True)
df.shape
```

```
<ipython-input-16-518fa402ec84>:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df.dropna(subset=subset_col, inplace=True)
```

Out[16]:

```
(18700, 25)
```

In [17]:

```
df.isnull().sum()
```

Out[17]:

```
Event.Id                 0
Investigation.Type       0
Accident.Number          0
Event.Date               0
Location                 0
Country                 47
Airport.Code             0
Airport.Name             0
Injury.Severity          0
Aircraft.damage          0
Registration.Number      0
Make                     3
```

```
Model                     12
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
Report.Status              0
Publication.Date           0
dtype: int64
```

In [18]:

```
#Filling in Null values
df.fillna(method='ffill', inplace=True)
df.isnull().sum()
```

```
C:\Users\ACDP-KENYA\anaconda3\envs\learn-env\lib\site-packages\pandas\core
\frame.py:4317: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  return super().fillna(
```

Out[18]:

```
Event.Id                  0
Investigation.Type        0
Accident.Number           0
Event.Date                0
Location                  0
Country                   0
Airport.Code              0
Airport.Name              0
Injury.Severity           0
Aircraft.damage           0
Registration.Number       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
Report.Status             0
Publication.Date          0
dtype: int64
```

In [19]:

```
#Checking for Duplicates
df.duplicated().sum()
```

Out[19]:

```
0
```

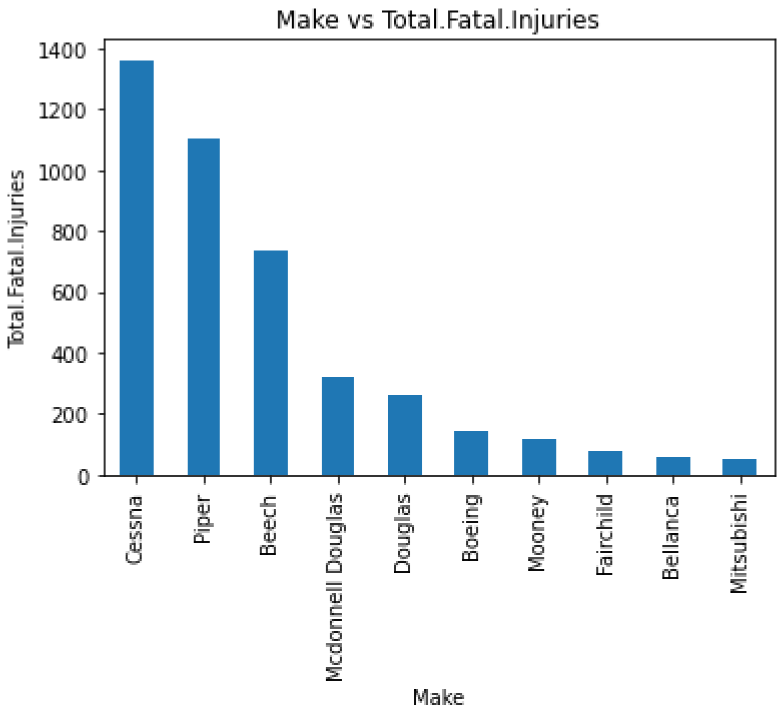
I have cleaned the data set, there may be some errors but I believe they will not cause an impact on the final findings of the investigation.

Data Visualisation and Exploratory Data Analysis.

From the above cleaning and exploration we can visualise some findings.

Identifying the riskiest Make against Fatal Injuries.

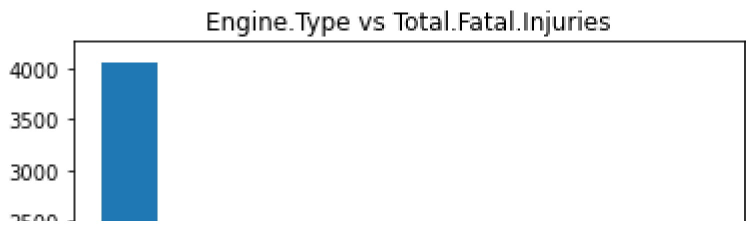
In [20]:
```
#Visualising Make vs Total.Fatal.Injuries
df.groupby('Make')['Total.Fatal.Injuries'].sum().sort_values(ascending=Fal
plt.title('Make vs Total.Fatal.Injuries')
plt.xlabel('Make')
plt.ylabel('Total.Fatal.Injuries')
plt.show()
```

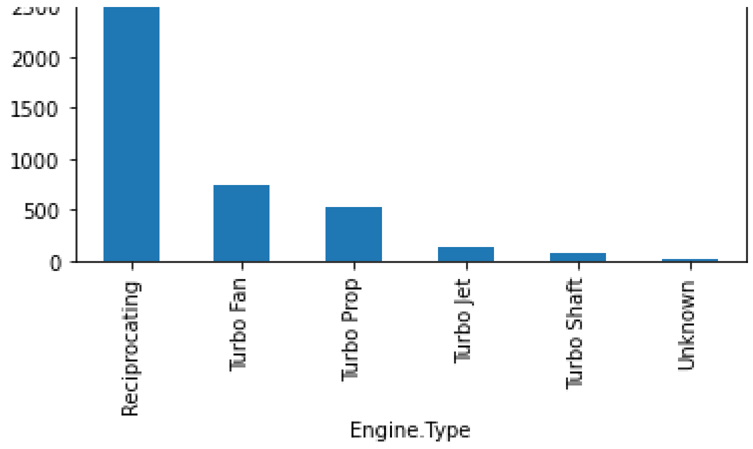


Identifying the riskiest Engine type against total fatalities.

In [21]:
```
#Visualisation of Engine.Type vs Total.Fatal.Injuries.
df.groupby('Engine.Type')['Total.Fatal.Injuries'].sum().sort_values(ascenc
plt.title('Engine.Type vs Total.Fatal.Injuries')
plt.xlabel('Engine.Type')
plt
```

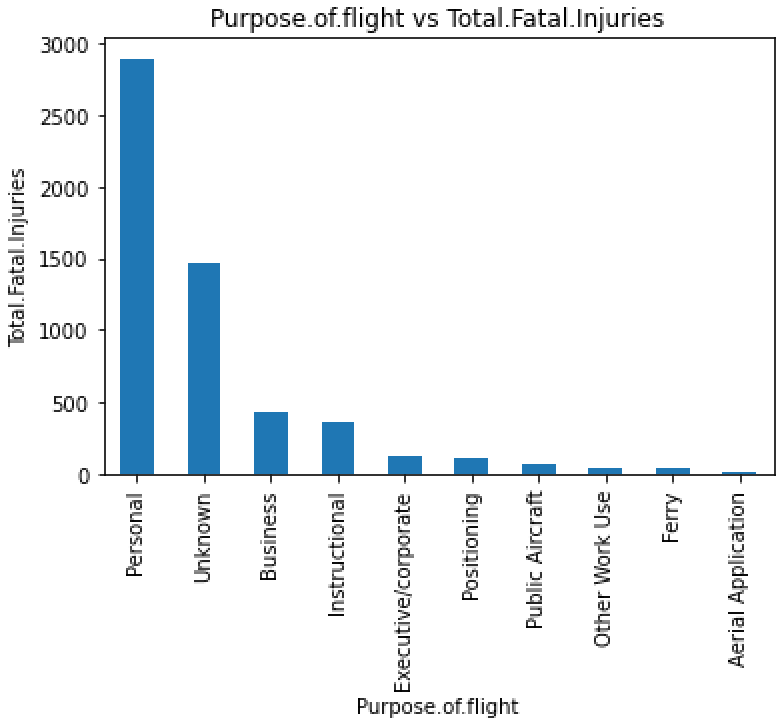
Out[21]:
```
<module 'matplotlib.pyplot' from 'C:\\Users\\ACDP-KENYA\\anaconda3\\envs
\\learn-env\\lib\\site-packages\\matplotlib\\pyplot.py'>
```





Identify which purpose of flight had the highest risk.

In [22]:
```
#Visualisation of Purpose.of.flight vs Total.Fatal.Injuries.
df.groupby('Purpose.of.flight')['Total.Fatal.Injuries'].sum().sort_values(
plt.title('Purpose.of.flight vs Total.Fatal.Injuries')
plt.xlabel('Purpose.of.flight')
plt.ylabel('Total.Fatal.Injuries')
plt.show()
```



Recommendations.

Aircraft Make

Cesena and Piper are the highest risk aircrafts and should be avoided. Mitsubishi had the lowest fatalities.

Aircraft Engine

Reciprocating Engine had the highest fatalities and should be avoided. Turbo shaft engines had very low fatalities and should be considered

Purpose of Flight

Personal perpose of flights had the highest fatalities and carry the highest risk of reason for flight.

Next Steps.