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    "### Business objective\n",
    "The primary aim of this project is to come up with a system that
accurately classifies whether an aircraft is high-risk or low-risk based
on the model and brand's history of accidents and incidents. \n",
    "\n",
    "This project will help come up with actionable insights that will
accurately advise and guide the head of the new aviation division to make
accurate and data-driven decisions on the purchase and operation of
airplanes for commercial and private enterprise as the company ventures
into this new business endeavor.\n",
    "\n",
    "### Business problem\n",
    "According to aviation and plane crash statistics, the odds of an
airplane crashing are approximately 0.000001%. Out of 816,545,929, the
chance of being killed in a plane crash is 1.\n",
    "Most factors that contribute to airplane crashes are normally out of
human control such as weather conditions, however, factors that play
significant roles in accident risks are aircraft model, maintenance and
oversight, all things that are humanly possible to control.\n",
    "\n",
    "\n",
    "Making purchases, especially when a company ventures into a business
they have no expertise, can prove to be daunting. This being the
foundational phase of a business, having expert advice significantly
increases the chances of having a successful business. However, as much
as human knowledge is valuable, it is also subjective and prone to
biases. There is a pressing need to have a more scientific and evidence-
based approach to help aviation businesses make informed decisions when
making purchases.\n",
    "\n",
    "### Value proposition\n",
    "This project seeks to help the head of the new aviation division
to;\n",
    "* Make informed decisions when deliberating over aircraft purchases.
Having an evidence-based approach will streamline the process of starting
this new endeavor, which in turn will help overcome common challenges
like a lack of experience and market uncertainties.\n",
    "\n",
    "* Eliminate the need of costly expert advisors who may have their
own agendas. Many atimes, experts already have companies that they
recommend to their clients, to whom they are biased towards, this project
aims to eradicate any biases and generate recommendations that will
actually be evidence-based.\n",
    "\n",
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    "* Accelerate the consultation process. A business consultation can
range from a few hours to several weeks or months, depending on different
factors. This project, however, will potentially lessen the time
significantly as the head of the new aviation division will already have
aircraft accurately classified from lowest risk to highest.\n",
    "\n",
    "* Enhance business outcomes of the new aviation business endeavor.
Having high risk aircraft can prove to be costly, when airline plane
crashes, the immediate business impact involves significant financial
losses, reputational damage, and potential long-term operational
challenges, having accurate information on low risk models help the head
of the new aviation division avert these crises in the future.\n",
    "\n",
    "### Business questions\n",
    "1. Which aircraft is the lowest risk for the company to start this
new business endeavor?\n",
    "2. What actionable insights can I offer the head of the new aviation
division to help decide which aircraft to purchase?\n",
    "\n",
    "### Project plan\n",
    "In this project, I will be using `AviationData.csv` as my data
source. To generate insights for the head of the new aviation division, I
will be using `Pandas` for data cleaning, imputation, analysis, and
`matplotlib` and `Seaborn` for visualization. \n",
    "\n",
    "### Success criteria\n",
    "Factors that will define success for this project include;\n",
    "* Achieving high accuracy in potential risk classification in
aircraft.\n",
    "* Generating meaningful and useful insights to help business
stakeholders make the best decisions and,\n",
    "* The ultimate success of the new business venture.\n"
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    "In this repository, under the file path `Data,` there are 2 CSV
files containing information about aviation accidents and incidents
documented by the USA National Transportation Safety Board (NTSB) between
1948 and 2022.\n",
    "\n",
    "The NTSB aviation accident database, `AviationData.csv`, contains
information from 1948 and later about civil aviation accidents and
selected incidents within the United States, its territories and
possessions, and in international waters.\n",
    "The `USState_Codes.csv` file contains information about the US
states and their abbreviations.\n",
    "\n",
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    "This dataset is most suitable for this particular project as it
contains information from as far back as 1948 and as recent as 2022,
which gives us a wide range of information to understand what works and
what does not in the aviation world.\n",
    "\n",
    "### Setup\n",
    "In the next cell, I am setting up my working environment by
importing the necessary libraries that I'll be using all through the
project. I will be using `Pandas` for data cleaning, imputation,
analysis, and `matplotlib` and `Seaborn` for visualization. "
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dataframe into the variable called `Aviation_data` and reading it. Also,
I am accessing the first and last 10 rows using the `.head()` and
`.tail()` methods. This will give me a feel of the data and help me
understand the structure of the data I am working with."
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This data possibly provides answers to what happened. Where? Why? When?
Who was involved? Among other important questions from looking at the
data at a glance. When dealing with aviation, it is important to
```

```
understand circumstances surrounding the incident or accident and by just
looking at the column names, it offers just that.\n",
    "\n",
    "Most rows contain `null values`, while others seem to have
incomprehensible abbreviations. Not being able to understand the data and
having lots of null values could skew the outcome.\n",
    "\n",
    "### Dataset summary\n",
    "To examine the data further, I am using `.info()` to look at the
overall dataset. This method gives a concise summary of the data which
will help me understand the data structure further. It will give me a
summary of how many records the data has, the number of null values and
the field identities in the data."
   ]
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      " 2   Accident.Number         88889 non-null  object \n",
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      " 23  Total.Fatal.Injuries    77488 non-null  float64\n",
```

```
      " 24  Total.Serious.Injuries  76379 non-null  float64\n",
      " 25  Total.Minor.Injuries    76956 non-null  float64\n",
      " 26  Total.Uninjured         82977 non-null  float64\n",
      " 27  Weather.Condition       84397 non-null  object \n",
      " 28  Broad.phase.of.flight   61724 non-null  object \n",
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the rest are either missing from as low as a hundred records to as many
as seven thousand records.\n",
    "`Schedule` has the most number of null values, whereas `Location`
has the least number of null values.\n",
    "\n",
    "The dataset has 5 columns containing the `float64` data type and 26
columns containing the `object` data type.\n",
    "\n",
    "### Null values and duplicated values\n",
    "I am checking for null values and duplicates in the data set. I will
be using the `.isna()` and the `.duplicated()` methods."
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an overview of the numerical data. This method generates descriptive
statistics of the data, giving measures of central tendency."
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"     <tr>\n",
"       <th>max</th>\n",
"       <td>8.000000</td>\n",
```

```
       "      <td>349.000000</td>\n",
       "      <td>161.000000</td>\n",
       "      <td>380.000000</td>\n",
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Total.Serious.Injuries  \\\n",
       "count       82805.000000          77488.000000            
76379.000000   \n",
       "mean            1.146585              0.647855                
0.279881   \n",
       "std             0.446510              5.485960                
1.544084   \n",
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0.000000   \n",
       "50%             1.000000              0.000000                
0.000000   \n",
       "75%             1.000000              0.000000                
0.000000   \n",
       "max             8.000000            349.000000              
161.000000   \n",
       "\n",
       "       Total.Minor.Injuries  Total.Uninjured  \n",
       "count          76956.000000     82977.000000  \n",
       "mean               0.357061         5.325440  \n",
       "std                2.235625        27.913634  \n",
       "min                0.000000         0.000000  \n",
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       "max              380.000000       699.000000  "
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     "metadata": {},
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    }
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    "Aviation_data.describe()"
   ]
  },
  {
   "cell_type": "markdown",
   "id": "79ac7d6c",
   "metadata": {},
```

```
   "source": [
    "The mean number of engines in aircrafts is 1.14, this does not give
us a lot of insigts as a lot of records are 0, which makes the data
ambiguous since it is not clear if this means the aircraft had 0 engines,
or it had 0 engines after the accident. The number 0 could also be a
placeholder because no aircraft can work without an engine, but we won't
be sure until we do furter analysis.\n",
    "\n",
    "For total fatal, serious, minor injuries and total uninjured, the
mean is also in 0s, which could be quite impossible given the fatality of
aircraft accidents. They could also be placeholders, but we cannot be
certain for sure.\n",
    "\n",
    "### Exploratory data analysis\n",
    "In this section, I am going to dig deeper into the dataset, trying
to look at each column closely, visualize, and identify relationships
between the data. This will help me identify which columns are most
relevant to the project to use.\n",
    "\n",
    "#### Top 15 years with the most accidents\n",
    "This is going to explore the top years when most of the accidents
took place between te years 1962 and 2021. This could give insights into
what was happening in those years in the aviation industry. I am using
data from the `Event.Date` column to extract my year. In this analysis I
am using `matpotlib` to create a bar chart, to visualize the findings."
   ]
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       "1        1962-07-19\n",
       "2        1974-08-30\n",
       "3        1977-06-19\n",
       "4        1979-08-02\n",
       "            ...    \n",
       "88884    2022-12-26\n",
       "88885    2022-12-26\n",
       "88886    2022-12-26\n",
       "88887    2022-12-26\n",
       "88888    2022-12-29\n",
       "Name: Event.Date, Length: 88889, dtype: object"
      ]
     },
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    }
```

```
   ],
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    "# Accessing the column to know what I am working with\n",
    "Aviation_data['Event.Date']"
   ]
  },
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    "##### Creating a new column"
   ]
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       "0    1948\n",
       "1    1962\n",
       "2    1974\n",
       "3    1977\n",
       "4    1979\n",
       "Name: Year, dtype: object"
      ]
     },
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     "metadata": {},
     "output_type": "execute_result"
    }
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   "source": [
    "# First step is to extract the year from the Event.Date column\n",
    "# To do this I have two options, to either change the column's data
type to a date, or create a Year column. I am going with the latter.\n",
    "# I am using the .map() method and the lambda function to achieve
this\n",
    "Aviation_data['Year'] = Aviation_data['Event.Date'].map(lambda x:
x[0:4])\n",
    "\n",
    "# Review the new column to confirm the code has worked\n",
    "Aviation_data['Year'].head()"
   ]
  },
  {
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   "metadata": {},
   "source": [
```

```
    "After creating a new column with the Years of the accident, the next
step is finding how many times in a year an aircraft accident occured.
Using the `.value_counts()` method, I'll find how many times a year
appears all through the records, giving me the number of accidents and
incidents that happended in that year."
   ]
  },
  {
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       "1982    3593\n",
       "1983    3556\n",
       "1984    3457\n",
       "1985    3096\n",
       "1986    2880\n",
       "1987    2828\n",
       "1988    2730\n",
       "1989    2544\n",
       "1990    2518\n",
       "1991    2462\n",
       "1992    2355\n",
       "1993    2313\n",
       "1995    2309\n",
       "1994    2257\n",
       "1998    2226\n",
       "2000    2220\n",
       "1999    2209\n",
       "1996    2187\n",
       "1997    2148\n",
       "2003    2085\n",
       "2001    2063\n",
       "2005    2031\n",
       "2002    2020\n",
       "2007    2016\n",
       "2004    1952\n",
       "2008    1893\n",
       "2006    1851\n",
       "2011    1850\n",
       "2012    1835\n",
       "2010    1786\n",
       "2009    1783\n",
       "2018    1681\n",
       "2016    1664\n",
       "2017    1638\n",
       "2019    1624\n",
       "2022    1607\n",
       "2015    1582\n",
       "2013    1561\n",
```

```
       "2021    1545\n",
       "2014    1535\n",
       "2020    1392\n",
       "1979       2\n",
       "1981       1\n",
       "1977       1\n",
       "1948       1\n",
       "1974       1\n",
       "1962       1\n",
       "Name: Year, dtype: int64"
      ]
     },
     "execution_count": 11,
     "metadata": {},
     "output_type": "execute_result"
    }
   ],
   "source": [
    "# Finding how many times a year occurs in the dataset.\n",
    "Aviation_data['Year'].value_counts()"
   ]
  },
  {
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   "metadata": {},
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    "The following step stores the findings in the list variables
`top_15_years` and `top_15_counts`. In this step, I am accessing the
first 15 objects in the code above and storing them in two lists, one
containing the year itself and the other containing the count of
accidents and incidents that year. It will also help us prepare our data
for visualization."
   ]
  },
  {
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   "metadata": {},
   "outputs": [],
   "source": [
    "# storing top 15 years and their counts into lists.\n",
    "top_15_years =
list(Aviation_data['Year'].value_counts().index[0:15])\n",
    "top_15_counts = list(Aviation_data['Year'].value_counts().head(15))"
   ]
  },
  {
   "cell_type": "markdown",
   "id": "b85be881",
   "metadata": {},
   "source": [
```

```
    "For better understanding, I am creating a bar chart for
visualization. I already have my `x- value` and my `height`, I am going
to set the titles, labels and customize my chart."
   ]
  },
  {
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    "From the chart above, it shows that there was a pattern from the
years between 1982 and 1995. During this time, the aviation industry saw
significant shifts, including airline deregulation, increased
competition, and the rise of hub-and-spoke networks. Fare wars,
bankruptcies, and mergers were common occurrences, while advancements in
aircraft technology and a growing focus on safety also occurred. \n",
    "\n",
    "In the chart, From 1982, the industry saw minimal but steady drop in
aircraft accidents up to 1995, which solidifies the industry's focus on
safety. This could help us identify what models were involved in these
accidents during the years under review, which could also help us monitor
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    "#### Top 10 Models and Makes involved in accidents\n",
    "From the previous chart, `Top 15 Years of Accidents`, I identified a
pattern, in 10 of the 15 years under review, the accidents were
decreasing at a steady pace. I had noted that decline was attributed to
advancements that were being made in the aircraft field during that time,
in this section, I am going to dig deeper into this to identify how
models and makes have evolved over time.\n",
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    "For this section, I will be using the `Year`, `Model`, and `Make`
columns. I will be using bar charts to compare the number of accidents
between the 20th Century and the 21st Century, as well as to identify the
top and bottom models and makes.\n",
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    "I will also compare the models and makes involved in accidents
between the 20th Century and the 21st Century, this will help identify
what models were advanced and which ones were not.\n",
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    "##### Twentieth century vs Twenty-first century\n",
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accidents during the period under review. I am using the
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involved in lots of accidents, as model 240-53 had only one accident in
the entirety of the period under review.\n",
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that got involved in accidents and incidents."
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```
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the Makes column\n",
    "Top_10_makes =
list(Aviation_data['Make'].value_counts().index[0:10])\n",
    "Top_10_makes_count =
list(Aviation_data['Make'].value_counts().head(10))\n",
    "\n",
    "# Bottom makes\n",
    "Bottom_10_makes =  list(Aviation_data['Make'].value_counts().index[-
10:])\n",
    "Bottom_10_makes_count =
list(Aviation_data['Make'].value_counts().tail(10))\n",
    "\n",
    "# preparing data for plotting\n",
    "# titles\n",
    "title_1 = \"Aircraft makes with the most accidents\"\n",
    "title_2 = \"Aircraft makes with the least accidents\"\n",
    "\n",
    "# labels\n",
    "x_label1 = \"Top 10 makes\"\n",
    "x_label2 = \"Bottom 10 makes\"\n",
    "y_label = 'Number of Accidents'\n",
    "\n",
    "# Plotting a figure with 2 bar charts\n",
    "plt.style.use('seaborn-darkgrid')\n",
    "fig, (ax1, ax2) = plt.subplots(figsize= (22, 6), ncols=2)\n",
    "\n",
    "# ax1\n",
    "ax1.bar(Top_10_makes, Top_10_makes_count)\n",
    "ax1.set_title(title_1)\n",
    "ax1.set_xlabel(x_label1)\n",
    "ax1.set_ylabel(y_label)\n",
    "\n",
    "# ax2\n",
    "ax2.bar(Bottom_10_makes, Bottom_10_makes_count)\n",
    "ax2.set_title(title_2)\n",
    "ax2.set_xlabel(x_label2)\n",
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Daniel L, Burkhart-grop and Kostrazewa Andre had the least recorded
accidents.\n",
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```

```
    "##### Models and makes in the 20th Century vs Models and makes in
the 21st Century\n",
    "Comparing Models in the 20th Century and the Models in the 21st
Century will help identify models and make that were advanced instead of
grouping all of them. This will give a clear perspective on the recent
past and help make well-informed decisions. The records from well before
the year 2000 could skew the data in the sense that during the 20th
Century experts in the field were trying new things, figuring out what
works and what doesn't and there is a possibility that in the 21st
Century, they have learnt from the mistakes of the previous Century and
made changes.\n",
    "\n",
    "##### Models in the 20th Century vs the 21st Century\n",
    "This part is going to use the `Twentieth_century` and the
`twenty1_century` datasets."
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`152` has the highest number of accidents, which changes in the 21st
Century as it is the third highest, having come down from over 1750
accidents to more than 400 accidents. Another thing from the charts is
that some of the models in the 20th century are not in the 21st-century
chart, such as the models 150, 150M, and PA-18.\n",
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values. I shall look at that during analysis.\n",
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list(Twentieth_century['Make'].value_counts().tail(10))\n",
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    "\n",
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```
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Century, but they have also reduced imensely, the scale in the 20th's
Century is 17500 accidents, in the 21st Century it is 5000 accidents,
telling us that the makes made advancements over the years. Just like in
the models chart, the makes bottom makes are unique.\n",
    "\n",
    "***Disclaimer:*** We cannot assume that the makes made advancements
in the 21st Century, because the centuries have different numbers of
recorded years.\n",
    "\n",
    "#### Purpose of flight\n",
    "In this section, I will be looking at the purposes of flight, which
will help when making decisions about what models and makes to purchase
for commercial and private enterprises, and what to avoid in the
same.\n",
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       "Banner Tow                      101\n",
       "Air Race show                    99\n",
       "Public Aircraft - Local          74\n",
       "Public Aircraft - State          64\n",
       "Air Race/show                    59\n",
       "Glider Tow                       53\n",
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This is important when looking at maintenance costs. When purchasing
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```

```
   "source": [
    "This proves that none of the numerical data in the dataset is
correlated with each other.\n",
    "\n",
    "### Columns I will be using\n",
    "Having gone through most of the columns, I have decided to only move
forward with the columns I find most relevant to this project. The
columns include;\n",
    "\n",
    "1. `Model` - As the project is about identifying aircraft to
purchase, this is the most relevant column. The column contains
information about the models of the aircraft that have been involved in
accidents. This will help pinpoint the exact aircraft to purchase, giving
me insight into what models are prone to accidents and which ones are
not.\n",
    "\n",
    "2. `Make` - Next to `Model`, this is the other important column.
This column contains information about which models belong to which make.
Several makes have the same types of models, which will help identify
which make the company should purchase a model from.\n",
    "\n",
    "3. `Engine.Type` - This column contains information about the kind
of engines the aircraft had. It is important for purposes of maintenance,
as it will help identify what engines are most favourable to have on an
aircraft.\n",
    "\n",
    "4. `Year` - This contains information about what year an accident
took place in. This will help monitor aircraft advancement through the
years. It is important to look at the years as they provide another
perspective other than `Model` and `Make`. Through the years, aircraft
have gone through advancements, and it is important to look at that as
well, instead of making a decision based on only one aspect.\n",
    "\n",
    "5. `Purpose.of.flight` - To find out the use of an aircraft, we need
to know its purpose. This column contains information about the purpose
of the aircraft, It is important because it will help identify if the
aircraft is for commercial or private use.\n",
    "\n",
    "### Data limitations\n",
    "Qualities that define good data, data that is reliable and useful
for a project, should be accurate, complete, consistent, valid, timely,
and unique. The `Aviation_data` lacks some of these qualities, making it
unusable for analysis. Here are the limitations;\n",
    "* Incompleteness - Out of 32 columns, only 5 columns contain
complete records. Missing values in data can lead to inaccuracies and
misleading results. If the data were to be used as it is, that could have
led to inaccurate and misleading results, which subsequently could have
led to losses in the company due to buying high-risk aircraft or any
other inaccurate information.\n",
    "* Inconsistent - Some columns in the dataset contain inconsistent
information. Some columns have the same name identified as separate
entities in the data; if used, the data could also cause inaccuracies and
misleading results. For example, in the plot `Top 21 Century Makes`, it
is evident that the column has inconsistent entries, `BOEING and Boeing`
```

```
are the same but have been presented as two makes in the visualization,
eroding the results.\n",
    "* Duplicates - The dataset contains more than 900 duplicated
records, which could skew the results as certain records provide the same
information twice. \n",
    "\n",
    "##  Data preparation\n",
    "In this section, I am going to prepare my data for analysis.
Exploratory Data Analysis is done to help figure out what is needed and
modify what has been mapped. This process will include data filtration,
data cleaning, data reformatting, and data integration. \n",
    "\n",
    "### Step 1 - Dropping Duplicates\n",
    "The `Aviation_data` contains 938 duplicated records. In this set, I
am using the `.drop_duplicates()` method to remove the records from the
data set, but since the other columns contain categorical data, I am
going to drop the record using the `Event.Id` column, because each record
has a unique ID. This is important to remove any possibility of skewing
results."
   ]
  },
  {
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   "execution_count": 25,
   "id": "a1fb9e1d",
   "metadata": {},
   "outputs": [],
   "source": [
    "# Dropping duplicates\n",
    "# In this code, the .drop_duplicates() method takes in the
parameters subset, to specify the column we want to use to drop the
duplicates and the parameter inplace, to modify the dataset.\n",
    "Aviation_data.drop_duplicates(subset= 'Event.Id', inplace= True)"
   ]
  },
  {
   "cell_type": "code",
   "execution_count": 26,
   "id": "975b77c0",
   "metadata": {},
   "outputs": [
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      ]
     },
     "execution_count": 26,
     "metadata": {},
     "output_type": "execute_result"
    }
   ],
   "source": [
    "# Confirming that duplicates have been dropped\n",
```

```
    "Aviation_data['Event.Id'].duplicated().sum()"
   ]
  },
  {
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   "id": "1c02b1dd",
   "metadata": {},
   "source": [
    "### Step 2 - Filtering our data\n",
    "The dataset contains 32 columns, of which most are irrelevant to
this project. In this step, I am filtering my data to only the columns
that will be relevant to the project. For the project, I will be using
the `Model`, `Make`, `Year`, `Purpose.of.flight`, and `Engine.Type`
columns. In the cell below, I will filter the columns and add them to a
new variable, namely, `Filtered_Aviation_data`."
   ]
  },
  {
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   "metadata": {},
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     "data": {
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       "        vertical-align: middle;\n",
       "    }\n",
       "\n",
       "    .dataframe tbody tr th {\n",
       "        vertical-align: top;\n",
       "    }\n",
       "\n",
       "    .dataframe thead th {\n",
       "        text-align: right;\n",
       "    }\n",
       "</style>\n",
       "<table border=\"1\" class=\"dataframe\">\n",
       "  <thead>\n",
       "    <tr style=\"text-align: right;\">\n",
       "      <th></th>\n",
       "      <th>Make</th>\n",
       "      <th>Model</th>\n",
       "      <th>Engine.Type</th>\n",
       "      <th>Year</th>\n",
       "      <th>Purpose.of.flight</th>\n",
       "    </tr>\n",
       "  </thead>\n",
       "  <tbody>\n",
       "    <tr>\n",
       "      <th>0</th>\n",
```

```
"      <td>Stinson</td>\n",
"      <td>108-3</td>\n",
"      <td>Reciprocating</td>\n",
"      <td>1948</td>\n",
"      <td>Personal</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>1</th>\n",
"      <td>Piper</td>\n",
"      <td>PA24-180</td>\n",
"      <td>Reciprocating</td>\n",
"      <td>1962</td>\n",
"      <td>Personal</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>2</th>\n",
"      <td>Cessna</td>\n",
"      <td>172M</td>\n",
"      <td>Reciprocating</td>\n",
"      <td>1974</td>\n",
"      <td>Personal</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>3</th>\n",
"      <td>Rockwell</td>\n",
"      <td>112</td>\n",
"      <td>Reciprocating</td>\n",
"      <td>1977</td>\n",
"      <td>Personal</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>4</th>\n",
"      <td>Cessna</td>\n",
"      <td>501</td>\n",
"      <td>NaN</td>\n",
"      <td>1979</td>\n",
"      <td>Personal</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>5</th>\n",
"      <td>Mcdonnell Douglas</td>\n",
"      <td>DC9</td>\n",
"      <td>Turbo Fan</td>\n",
"      <td>1979</td>\n",
"      <td>NaN</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>6</th>\n",
"      <td>Cessna</td>\n",
"      <td>180</td>\n",
"      <td>Reciprocating</td>\n",
"      <td>1981</td>\n",
"      <td>Personal</td>\n",
"    </tr>\n",
```

```
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       "      <td>Cessna</td>\n",
       "      <td>140</td>\n",
       "      <td>Reciprocating</td>\n",
       "      <td>1982</td>\n",
       "      <td>Personal</td>\n",
       "    </tr>\n",
       "    <tr>\n",
       "      <th>8</th>\n",
       "      <td>Cessna</td>\n",
       "      <td>401B</td>\n",
       "      <td>Reciprocating</td>\n",
       "      <td>1982</td>\n",
       "      <td>Business</td>\n",
       "    </tr>\n",
       "    <tr>\n",
       "      <th>9</th>\n",
       "      <td>North American</td>\n",
       "      <td>NAVION L-17B</td>\n",
       "      <td>Reciprocating</td>\n",
       "      <td>1982</td>\n",
       "      <td>Personal</td>\n",
       "    </tr>\n",
       "  </tbody>\n",
       "</table>\n",
       "</div>"
      ],
      "text/plain": [
       "                Make         Model    Engine.Type  Year
Purpose.of.flight\n",
       "0            Stinson         108-3  Reciprocating  1948
Personal\n",
       "1              Piper      PA24-180  Reciprocating  1962
Personal\n",
       "2             Cessna          172M  Reciprocating  1974
Personal\n",
       "3           Rockwell           112  Reciprocating  1977
Personal\n",
       "4             Cessna           501            NaN  1979
Personal\n",
       "5  Mcdonnell Douglas           DC9      Turbo Fan  1979
NaN\n",
       "6             Cessna           180  Reciprocating  1981
Personal\n",
       "7             Cessna           140  Reciprocating  1982
Personal\n",
       "8             Cessna          401B  Reciprocating  1982
Business\n",
       "9     North American  NAVION L-17B  Reciprocating  1982
Personal"
      ]
     },
     "execution_count": 27,
```

```
     "metadata": {},
     "output_type": "execute_result"
    }
   ],
   "source": [
    "# First, I am storing the columns in a list variable\n",
    "Relevant_columns = ['Make', 'Model', 'Engine.Type', 'Year',
'Purpose.of.flight']\n",
    "\n",
    "# Then I am filtering Aviation_data and retrieving the columns I
need and storing them in the variable Filtered_Aviation_data\n",
    "Filtered_Aviation_data = Aviation_data[Relevant_columns]\n",
    "\n",
    "# Accessing the first 10 records\n",
    "Filtered_Aviation_data.head(10)"
   ]
  },
  {
   "cell_type": "markdown",
   "id": "9b9cccbc",
   "metadata": {},
   "source": [
    "In the next part, I am getting a summary of the new dataset to
figure out how to clean my data. I am using the `.info()` method."
   ]
  },
  {
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   "execution_count": 28,
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   "metadata": {},
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     "name": "stdout",
     "output_type": "stream",
     "text": [
      "<class 'pandas.core.frame.DataFrame'>\n",
      "Int64Index: 87951 entries, 0 to 88888\n",
      "Data columns (total 5 columns):\n",
      " #   Column             Non-Null Count  Dtype \n",
      "---  ------             --------------  ----- \n",
      " 0   Make               87888 non-null  object\n",
      " 1   Model              87859 non-null  object\n",
      " 2   Engine.Type        80927 non-null  object\n",
      " 3   Year               87951 non-null  int64 \n",
      " 4   Purpose.of.flight  81829 non-null  object\n",
      "dtypes: int64(1), object(4)\n",
      "memory usage: 4.0+ MB\n"
     ]
    }
   ],
   "source": [
    "Filtered_Aviation_data.info()"
   ]
```

```
  },
  {
   "cell_type": "markdown",
   "id": "bf9fdc03",
   "metadata": {},
   "source": [
    "### Step 3 - Dropping Null values\n",
    "Missing values lead to inaccuracies and misleading results, it is
therefore imperative that we have a complete dataset. In the cell above,
all but one column contains complete records. There are three options to
choose from: either fill in the null values, drop them, or keep them. In
this project, I cannot keep them as they do not add any information, I
cannot also fill the null values as that could introduce noise into the
dataset, leaving us with one option: dropping them.\n",
    "\n",
    "Since 4 out of 5 columns contain missing values, I am going to use
the `.dropna()` method to drop all the rows that contain null values. "
   ]
  },
  {
   "cell_type": "code",
   "execution_count": 29,
   "id": "e481f864",
   "metadata": {},
   "outputs": [
    {
     "data": {
      "text/plain": [
       "Make                 0\n",
       "Model                0\n",
       "Engine.Type          0\n",
       "Year                 0\n",
       "Purpose.of.flight    0\n",
       "dtype: int64"
      ]
     },
     "execution_count": 29,
     "metadata": {},
     "output_type": "execute_result"
    }
   ],
   "source": [
    "# Dropping rows with null values\n",
    "\"\"\"I am dropping the rows instead of the columns because we need
the columns for our analysis and also dropping the columns will not make
us lose data\"\"\"\n",
    "\n",
    "Filtered_Aviation_data = Filtered_Aviation_data.dropna()\n",
    "\n",
    "# Confirming if all the rows containing null values are dropped\n",
    "Filtered_Aviation_data.isna().sum()"
   ]
  },
  {
```

```
   "cell_type": "code",
   "execution_count": 30,
   "id": "c25a3e6a",
   "metadata": {},
   "outputs": [
    {
     "data": {
      "text/plain": [
       "(78081, 5)"
      ]
     },
     "execution_count": 30,
     "metadata": {},
     "output_type": "execute_result"
    }
   ],
   "source": [
    "# This code looks at the shape of the data after dropping null
values\n",
    "Filtered_Aviation_data.shape"
   ]
  },
  {
   "cell_type": "markdown",
   "id": "9f09b9b8",
   "metadata": {},
   "source": [
    "After dropping the missing values, the dataset contains 78081 rows
and 5 columns. This step was crucial for analysis, just as the rule of
thumb says, garbage in, garbage out; clean data in, clean results out.
\n",
    "\n",
    "### Step 4 - Standardization\n",
    "During EDA, I identified that most columns had different entries,
which meant or were the same thing. Standardization is important because
it helps get accurate data. So, this step is going to standardize the
record for each column, I will be using string methods such as
`.replace()`, `.strip()`, among others.\n",
    "I am going to start with the `Make` column, first I'll be looking at
all the values using the `.value_count()` method, to identify the records
that are repeated. Then I'll standardize them."
   ]
  },
  {
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   "execution_count": 31,
   "id": "3a4e9879",
   "metadata": {},
   "outputs": [
    {
     "data": {
      "text/plain": [
       "Cessna           21375\n",
       "Piper            11647\n",
```

```
       "Beech            4139\n",
       "CESSNA           3753\n",
       "PIPER            2234\n",
       "                 ...  \n",
       "Petracca            1\n",
       "TERATORN            1\n",
       "Little              1\n",
       "TUCKER-HURNI        1\n",
       "Skilling            1\n",
       "Name: Make, Length: 7564, dtype: int64"
      ]
     },
     "execution_count": 31,
     "metadata": {},
     "output_type": "execute_result"
    }
   ],
   "source": [
    "# Looking at the unique values\n",
    "Filtered_Aviation_data['Make'].value_counts()"
   ]
  },
  {
   "cell_type": "markdown",
   "id": "ffd8cde2",
   "metadata": {},
   "source": [
    "From the code above, there were two types of entries: Capitalized
entry and Title entry. To standardize this, I am going to map the column
and use the lambda function to turn all the records to Title form using
the string method `.title()`"
   ]
  },
  {
   "cell_type": "code",
   "execution_count": 32,
   "id": "957ccb0a",
   "metadata": {},
   "outputs": [],
   "source": [
    "# Standardizing the Make column\n",
    "Filtered_Aviation_data['Make'] =
Filtered_Aviation_data['Make'].map(lambda x: x.title())"
   ]
  },
  {
   "cell_type": "code",
   "execution_count": 33,
   "id": "686f9dbd",
   "metadata": {},
   "outputs": [
    {
     "data": {
      "text/plain": [
```

```
       "Cessna      25128\n",
       "Piper       13881\n",
       "Beech        4891\n",
       "Bell         2264\n",
       "Mooney       1263\n",
       "             ...  \n",
       "Overton         1\n",
       "Dayon           1\n",
       "Gyroflug        1\n",
       "Dawe            1\n",
       "Skilling        1\n",
       "Name: Make, Length: 7032, dtype: int64"
      ]
     },
     "execution_count": 33,
     "metadata": {},
     "output_type": "execute_result"
    }
   ],
   "source": [
    "Filtered_Aviation_data['Make'].value_counts()"
   ]
  },
  {
   "cell_type": "markdown",
   "id": "81bc0374",
   "metadata": {},
   "source": [
    "In the code above, the column has been standardized and the number
of values has also gone up, indicating that there were inconsistencies
when the data was being collected.\n",
    "\n",
    "Next, I'll be working on the `Purpose of.flight column. This column
has the same problem as the previous one, but this is not about
capitalization. In this column, some of the data was abbreviated, some
was not, and others were given a twist in their name, but they mean the
same thing. So in this step, I am going to replace the abbreviated and
twisted data and give them one name.\n",
    "\n",
    "I will be starting with the .value_count method to identify these
names, then I will replace them using the `.replace()` method."
   ]
  },
  {
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   "execution_count": 34,
   "id": "6bf96d17",
   "metadata": {},
   "outputs": [
    {
     "data": {
      "text/plain": [
       "Personal                        46872\n",
       "Instructional                   10008\n",
```

```
       "Unknown                       6310\n",
       "Aerial Application            4544\n",
       "Business                      3812\n",
       "Positioning                   1561\n",
       "Other Work Use                1119\n",
       "Ferry                          784\n",
       "Aerial Observation             706\n",
       "Public Aircraft                693\n",
       "Executive/corporate            515\n",
       "Flight Test                    372\n",
       "Skydiving                      170\n",
       "External Load                  103\n",
       "Banner Tow                      95\n",
       "Public Aircraft - Federal       95\n",
       "Air Race show                   72\n",
       "Public Aircraft - Local         71\n",
       "Public Aircraft - State         63\n",
       "Air Race/show                   42\n",
       "Glider Tow                      37\n",
       "Firefighting                    24\n",
       "Air Drop                         8\n",
       "ASHO                             2\n",
       "PUBS                             2\n",
       "PUBL                             1\n",
       "Name: Purpose.of.flight, dtype: int64"
      ]
     },
     "execution_count": 34,
     "metadata": {},
     "output_type": "execute_result"
    }
   ],
   "source": [
    "# Identifying abbreviated and twisted records.\n",
    "Filtered_Aviation_data['Purpose.of.flight'].value_counts()"
   ]
  },
  {
   "cell_type": "markdown",
   "id": "bfb074f9",
   "metadata": {},
   "source": [
    "In the code above, Public Aircraft, Public Aircraft - Federal,
Public Aircraft - Local, Public Aircraft -State as well as PUBS and PUBL
mean the same thing. Air Race Show and Air Race/show also mean the same
thing. Also, Ferry and positioning mean the same thing, as both have the
same meaning, a flown aircraft without passangers or cargo. In the next
cell I will be fixing this."
   ]
  },
  {
   "cell_type": "code",
   "execution_count": 35,
   "id": "317795b0",
```

```
   "metadata": {},
   "outputs": [],
   "source": [
    "# Changing inconsistent data to one, standardized record.\n",
    "# Replacing Public Aircraft - Federal, Public Aircraft - Local,
Public Aircraft -State, PUBS and PUBL to 'Public Aircraft'\n",
    "Filtered_Aviation_data['Purpose.of.flight'].replace('Public Aircraft
- Federal', 'Public Aircraft', inplace= True)\n",
    "Filtered_Aviation_data['Purpose.of.flight'].replace('Public Aircraft
- Local', 'Public Aircraft', inplace= True)\n",
    "Filtered_Aviation_data['Purpose.of.flight'].replace('Public Aircraft
- State', 'Public Aircraft', inplace= True)\n",
    "Filtered_Aviation_data['Purpose.of.flight'].replace('PUBS', 'Public
Aircraft', inplace= True)\n",
    "Filtered_Aviation_data['Purpose.of.flight'].replace('PUBL', 'Public
Aircraft', inplace= True)\n",
    "\n",
    "# Replacing Air Race/show with Air Race Show\n",
    "Filtered_Aviation_data['Purpose.of.flight'].replace('Air Race/show',
'Air Race show', inplace= True)\n",
    "\n",
    "# Replacing Positioning with Ferry\n",
    "Filtered_Aviation_data['Purpose.of.flight'].replace('Positioning',
'Ferry', inplace= True)"
   ]
  },
  {
   "cell_type": "markdown",
   "id": "a73fba6b",
   "metadata": {},
   "source": [
    "`Engine.Type` column also has a standardization issue, some of its
data is entered in abbreviated form and long form, some has been entered
in both capitalized form and lower form. In this next code, I am going to
replace all the abbreviations with their full forms and the capitalized
forms with their title forms."
   ]
  },
  {
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   "execution_count": 36,
   "id": "81f8cfb4",
   "metadata": {},
   "outputs": [
    {
     "data": {
      "text/plain": [
       "Reciprocating    68054\n",
       "Turbo Shaft       3190\n",
       "Turbo Prop        2882\n",
       "Unknown           1984\n",
       "Turbo Fan         1380\n",
       "Turbo Jet          558\n",
       "None                19\n",
```

```
       "Electric             9\n",
       "LR                   2\n",
       "NONE                 2\n",
       "UNK                  1\n",
       "Name: Engine.Type, dtype: int64"
      ]
     },
     "execution_count": 36,
     "metadata": {},
     "output_type": "execute_result"
    }
   ],
   "source": [
    "Filtered_Aviation_data['Engine.Type'].value_counts()"
   ]
  },
  {
   "cell_type": "code",
   "execution_count": 37,
   "id": "d0098458",
   "metadata": {},
   "outputs": [],
   "source": [
    "Filtered_Aviation_data['Engine.Type'].replace('NONE', 'None', 
inplace= True)\n",
    "Filtered_Aviation_data['Engine.Type'].replace('UNK', 'Unknown', 
inplace= True)\n",
    "Filtered_Aviation_data['Engine.Type'].replace('LR', 'Long Range', 
inplace= True)"
   ]
  },
  {
   "cell_type": "markdown",
   "id": "0a4c3324",
   "metadata": {},
   "source": [
    "This step was crucial to ensure data accuracy, reliability, and 
uniformity of the data, which helps eliminate redundancies and errors."
   ]
  },
  {
   "cell_type": "code",
   "execution_count": 38,
   "id": "95802059",
   "metadata": {},
   "outputs": [
    {
     "data": {
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       "        vertical-align: middle;\n",
       "    }\n",
```

```
"\n",
"    .dataframe tbody tr th {\n",
"        vertical-align: top;\n",
"    }\n",
"\n",
"    .dataframe thead th {\n",
"        text-align: right;\n",
"    }\n",
"</style>\n",
"<table border=\"1\" class=\"dataframe\">\n",
"  <thead>\n",
"    <tr style=\"text-align: right;\">\n",
"      <th></th>\n",
"      <th>Make</th>\n",
"      <th>Model</th>\n",
"      <th>Engine.Type</th>\n",
"      <th>Year</th>\n",
"      <th>Purpose.of.flight</th>\n",
"    </tr>\n",
"  </thead>\n",
"  <tbody>\n",
"    <tr>\n",
"      <th>0</th>\n",
"      <td>Stinson</td>\n",
"      <td>108-3</td>\n",
"      <td>Reciprocating</td>\n",
"      <td>1948</td>\n",
"      <td>Personal</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>1</th>\n",
"      <td>Piper</td>\n",
"      <td>PA24-180</td>\n",
"      <td>Reciprocating</td>\n",
"      <td>1962</td>\n",
"      <td>Personal</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>2</th>\n",
"      <td>Cessna</td>\n",
"      <td>172M</td>\n",
"      <td>Reciprocating</td>\n",
"      <td>1974</td>\n",
"      <td>Personal</td>\n",
"    </tr>\n",
"    <tr>\n",
"      <th>3</th>\n",
"      <td>Rockwell</td>\n",
"      <td>112</td>\n",
"      <td>Reciprocating</td>\n",
"      <td>1977</td>\n",
"      <td>Personal</td>\n",
"    </tr>\n",
"    <tr>\n",
```

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    "In this section, I am going to use the cleaned data to answer the 
business questions raised. I am also going to come up with questions that 
will help me generate insights.\n",
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    "\n",
    "### Q1. Which aircraft are the lowest risk?\n",
    "Something low-risk is something that has a low level of danger. In
this part, I am going to identify aircraft with the lowest risk when it
comes to accidents and incidents. However, the `Filtered_Aviation_data`
contains data from 1948 to 2022. It is important to note that this group
includes all aircraft before and after significant shifts in the aircraft
industry. Therefore, to answer this question better, I am going to look
at the models with the lowest accident frequency in the 21st Century.\n",
    "\n",
    "With the emergence of technology, it would be inaccurate to group
aircraft that operated during the 20th Century with technology and
aircraft that were built in the 21st Century, with advancements such as
lighter material, the technology at hand, among other factors. \n",
    "\n",
    "Additionally, when it comes to business, the customer is always
right, killing two birds with one stone, I am going to use the
`Purpose.of.flight` column to identify what models were used for what
purposes to help the head of the new aviation division purchase aircraft
that suits the company's purpose. \n",
    "\n",
    "In this section, I am going to filter the records from years after
the year 2000 and store them in the variable, `Twenty_first_century`.
Further, to get the records for the Personal, Business, and Public
Aircraft purposes of flight, I am going to filter the data to include the
above-mentioned purposes of flights. This is crucial for the project as
the goal is to identify low-risk aircraft for commercial and private
flights. This will help in determining what aircraft are suitable for
either commercial or private use. \n",
    "\n",
    "Using the `Model` and `Year` and `Purpose.of.flight` columns, I am
going to plot 3 bar graphs, each for every purpose that will give me the
aircraft with the lowest accident frequency in the 21st Century where the
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the 21st Century\n",
    "Twenty_first_century =
Filtered_Aviation_data[Filtered_Aviation_data['Year'] > 2000]\n",
    "\n",
    "# Second step, I am filtering my data for the three purposes using
the equal comparison operation '=='.\n",
```

```
    "# This is a crucial step for convinience and it will also make the
code simple.\n",
    "# Personal Flight\n",
    "Personal_flight =
Twenty_first_century[Twenty_first_century['Purpose.of.flight'] ==
'Personal']\n",
    "\n",
    "# Business Flight\n",
    "Business_flight =
Twenty_first_century[Twenty_first_century['Purpose.of.flight'] ==
'Business']\n",
    "\n",
    "# Public Aircraft\n",
    "Public_aircraft =
Twenty_first_century[Twenty_first_century['Purpose.of.flight'] == 'Public
Aircraft']\n",
    "\n",
    "# In this step, I am preparing my data for the three plots using the
the .value_counts() method on each of the above datasets.\n",
    "# I am retrieving all the data from the column `Model`, using their
values for the x axes and the counts for the plot's y axes.\n",
    "# To retrieve them, I am using the `.index[]` method to get the
values by slicing through them. To get the counts, I am using the
`.tail()` method.\n",
    "# Personal Flight\n",
    "personal_aircraft =
list(Personal_flight['Model'].value_counts().index[-5:])\n",
    "personal_aircraft_counts =
list(Personal_flight['Model'].value_counts().tail(5))\n",
    "\n",
    "# Business Flight\n",
    "business_aircraft =
list(Business_flight['Model'].value_counts().index[-5:])\n",
    "business_aircraft_counts =
list(Business_flight['Model'].value_counts().tail(5))\n",
    "\n",
    "# Public Aircraft\n",
    "public_aircraft =
list(Public_aircraft['Model'].value_counts().index[-5:])\n",
    "public_aircraft_counts =
list(Public_aircraft['Model'].value_counts().tail(5))\n",
    "\n",
    "# Title and labels\n",
    "# Next I am storing the plots' titles and labels in variables, this
is for convininece and easy acces when plotting the graphs.\n",
    "title_1 = 'Personal Flight Aircraft'\n",
    "title_2 = 'Business Flight Aircraft'\n",
    "title_3 = 'Public Flight Aircraft'\n",
    "x_label = 'Model'\n",
    "y_label = 'Frequency'\n",
    "\n",
    "# In this part I am plotting a bar graph, this is the most suitable
graph to use when comparing things\n",
    "# customizing figure and plot \n",
```

```
    "plt.style.use('fivethirtyeight')\n",
    "fig, axs = plt.subplots(figsize= (30,10), ncols=3)\n",
    "\n",
    "\n",
    "#ax1\n",
    "axs[0].bar(personal_aircraft, personal_aircraft_counts)\n",
    "axs[0].set_title(title_1)\n",
    "axs[0].set_xlabel(x_label)\n",
    "axs[0].set_ylabel(y_label)\n",
    "\n",
    "#ax2\n",
    "axs[1].bar(business_aircraft, business_aircraft_counts)\n",
    "axs[1].set_title(title_2)\n",
    "axs[1].set_xlabel(x_label)\n",
    "axs[1].set_ylabel(y_label)\n",
    "\n",
    "#ax3\n",
    "axs[2].bar(public_aircraft, public_aircraft_counts)\n",
    "axs[2].set_title(title_3)\n",
    "axs[2].set_xlabel(x_label)\n",
    "axs[2].set_ylabel(y_label)\n",
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    "plt.tight_layout();"
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purchases?\n",
    "While an aircraft model refers to the specific design and features
of an airplane, \"make\" refers to the manufacturer. An aircraft model
can have different makes, as different companies can produce the same
type of plane. In this section, I am going to find the manufacturers with
the lowest accident rates in the records. This discovery will go hand in
hand with the model's discovery, helping the head of the new aviation
division purchase the aircraft with the lowest risk possible, both on
models and makes.\n",
    "\n",
    "I will still be using a bar graph because this is a comparison, I
will also be using the `Twenty_first_century` dataset, for accuracy."
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    "# I am using the data from the `Make` column and using its values
for the x axis and the counts for the plot's y axis.\n",
    "# To retrieve them, I am using the `.index[]` method to get the
bottom 10 values by slicing through them. To get the bottom 10 counts, I
am using the `.tail()` method.\n",
    "Low_risk_21C_makes =
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list(Twenty_first_century['Make'].value_counts().tail(10))\n",
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    "#This code is preparing the titles and labels for plotting by
storing the titles and labels in variables for convinience when
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    "y_label = 'Accident Counts'\n",
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and plot \n",
    "plt.style.use('fivethirtyeight')\n",
    "fig, ax = plt.subplots(figsize = (25, 7))\n",
    "\n",
    "# Plotting the bar graph\n",
    "ax.bar(Low_risk_21C_makes, Low_risk_21C_makes_counts)\n",
    "\n",
    "#setting the title, label and adjusting the layout\n",
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    "### Recommendation 1\n",
    "After thorough analysis of the `Filtered_Aviation_data` on Aviation
accidents databases and synopses, I strongly recommend that the head of
the new aviation division consider purchasing the 'MBB BK 117 C-2', 'UH
1H', '500D', 'H500D', '207', 'HAWKER', 'L-39', 'Prescott Pusher', 'M20E',
'2T 1A', 'ZENAIR CH 701 SP', 'CRICKET MC12', 'Super Cub Replica', 'DH-82-
C', and 'Navion H' models. These models have demonstrated the lowest
operational risk among thousands of comparable aircraft, showing
exceptional reliability and minimal accident rates even after the
industry's advancements and significant strides, as well as advanced
technology.\n",
    "\n",
    "Also, I recommend that the head of the new avation division consider
purchasing models from 'Brinkerhuff Gerald G', 'Backovich George C',
'Kolb Aircraft Co', 'Roberts Bruce W', 'Purvis', 'Cano Dave', 'Zivko',
and 'Terrence A. Sack' aircraft manufactures. These makes have been
proven to have the lowest risks based on their low accident rates.\n",
    "\n",
    "Having identified these makes and models from a sea of records, I
strongly believe that safety records, combined with modern and advanced
flight systems, make the above models and makes the ideal choices for
companies starting their aviation journey. These models and makes will
also help maximize operations, positioning the company for growth.\n",
    "\n",
    "\n",
    "### Recommendation 2\n",
    "The project at hand looks to identify low-risk aircraft for
commercial and private use. After carefully analyzing the data, I have
identified aircraft that I strongly recommend the head of the new
aviation division consider using for the two intended purposes. I
recommend the use of the 'ZENAIR CH 701 SP', 'CRICKET MC12', 'Super Cub
Replica', 'DH-82-C', and 'Navion H' models for Private use. \n",
    "\n",
    "The models above were used for personal flights. Personal flight
refers to a flight operated for private or individual purposes, rather
than for commercial or business travel. This can include leisure travel,
flying for recreation, or even flights related to hobbies or personal
events. It is based on the meaning and the low-risk aspect that I
recommend the aircraft above for this purpose.\n",
    "\n",
    "For commercial use, I recommend the use of the 'MBB BK 117 C-2', 'UH
1H', '500D', 'H500D', and '207' models.  As the name suggests, these
models were built and designed for that purpose.\n",
    "\n",
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    "The last recommendation on the purpose of aircraft, I recommend the
use of the 'HAWKER', 'L-39', 'Prescott Pusher', 'M20E', and '2T 1A'
models for both of the intended purposes. These aircraft can serve either
the purposes of commercial or private flights. \n",
    "\n",
    "These models, when used for the specified purposes, could maximize
operations to grow in the increasingly competitive market.\n",
    "\n",
    "\n",
    "***Disclaimer*** It is important to note that these are just a
handful of the low-risk models and make, to find more aircraft and models
that would suit your budget, the head of the new aviation could use
[tableau
visualizations](https://public.tableau.com/views/AircraftPurchaseRecommen
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to use?\n",
    "To answer this question, I am going to look at the engine types with
the least number of accidents. An engine is the powerhouse of an
aircraft; having a good engine means having a good aircraft. This is a
crucial part when purchasing aircraft, having a good engine reduces
costly maintenance repairs and adds to the low-risk aspect of the
aircraft.\n",
    "\n",
    "I am going to use a bar graph to compare the engine types involved
in accidents in the 21st Century, just like in the question above, to
include the perspective of advanced technology and all."
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the dataframe using the .value_counts() method.\n",
    "# I am retrieving all the data from the column `Engine.Type`, using
its values for the x axis and the counts for the plot's y axis.\n",
    "# To retrieve them, I am using the `.index[]` method to get the
values by slicing through them. To get the counts, I am using the
`.head()` method.\n",
    "Engine_type =
list(Twenty_first_century['Engine.Type'].value_counts().index[0:10])\n",
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list(Twenty_first_century['Engine.Type'].value_counts().head(10))\n",
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is for convininiece and easy acces when plotting the graph.\n",
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    "# In this part I am plotting a bar graph, this is the most suitable
graph to use when comparing things\n",
    "# customizing figure and plot \n",
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    "# Plotting the bar graph\n",
    "ax.bar(Engine_type, Engine_count)\n",
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    "### Recommendation 3\n",
    "A good purchase goes hand in hand with maintenance, as much as
purchasing a low risk aircraft looks at the safety aspect of the
aircraft, it also focuses on costs and longterm suitability. It is at the
back of these aspects that I strongly recommend Long Range 'LR' and
electric engines to be considered as the engine types for the models to
be purchased.\n",
    "\n",
    "According to my analysis, the two engined recommended have accident
rates on less than 5 in 22 years. This proves the engines' suitability
for long-term operations, eradicating the need for costly maintenance
repairs that would otherwise dig holes into the company's pockets.\n",
    "\n",
    "## Conclusion\n",
    "#### Overview\n",
    "The project was meant to come up with a system that accurately
classifies whether an aircraft is high-risk or low-risk based on the
model and brand's history of accidents and incidents and identify and
recommend low-risk aircraft to help and guide the head of the new
aviation division to purchase aircraft for the company's new business
endeavor.\n",
    "\n",
    "#### Key Findings\n",
    "After the processes of Explorative Data Analysis and data cleaning,
I identified 15 aircraft models, 10 makes and 2 engine types that proved
to be low-risk and recommended them to the head of the new aviation
division, and specified the use of each and every model for the purchase
of aircraft for commercial and private use. \n",
    "\n",
    "#### Impact\n",
    "The project wll help the head of the new aviation division
prioritize aircraft with the best safety records, reducing the likelihood
of accidents or incidents, which in turn will boost passenger confidence.
It will also help reduce financial costs, a low-risk aircraft means less
```

```
unscheduled repairs and lower insuarance costs, which will help the
company save money.\n",
    "\n",
    "For companies starting up in the business, this project will help
them make data-driven decisions, which will eliminate the need for costly
expert advisors who may have their agendas. Many times, experts already
have companies that they recommend to their clients, to whom they are
biased towards; this project aims to eradicate any biases and generate
recommendations that will be evidence-based.\n",
    "\n",
    "Additionally, it will enhance their business outcomes. High-risk
aircraft can prove to be costly, when airline plane crashes, the
immediate business impact involves significant financial losses,
reputational damage, and potential long-term operational challenges.
Having accurate information on low risk models help them avert these
crises in the future.\n",
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