FedEx Visualization Interview Project

September 23, 2022

1 FedEx AOD - Data Visualization

1.1 Data Preparation

[190]:

```python
# Importing required libraries

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import random
import matplotlib.colors as mcolors
import seaborn as sns
from wordcloud import WordCloud
from wordcloud import ImageColorGenerator
from wordcloud import STOPWORDS
from statsmodels.graphics.mosaicplot import mosaic
import warnings
warnings.filterwarnings('ignore') # Just to ignore future package release notes
```

[191]:

```python
# Loading in the data where each sheet is a different dataframe

xls = pd.ExcelFile("visualization_sample_set_interview_practical.xlsx")
df1 = pd.read_excel(xls, "Source")
df2 = pd.read_excel(xls, "Impl")
df3 = pd.read_excel(xls, "Monitoring")
```

[192]:

```python
# Inspecting the data

display(df1.head())
df1.info()

df2 = df2.drop('SN', 1) #  dropping first column, unnecessary index
display(df2.head())
df2.info()

df3 = df3.drop('SN', 1) # dropping first column, unnecessary index
display(df3.head())
```

```
df3.info()

## We observe that in the first sheet, almost half of the value in the␣
 ↪'Submitted By' and 'Plan ID' column are
## missing. Similarly in the second sheet many values for 'Channels', 'End␣
 ↪Date', 'Responsible 1', 'Mitigation Type'
## are missing, and almost all values for 'Responsible 2' are missing. Sheet 3␣
 ↪has a lot of missing values for
## 'Lower Limit Value', 'Upper Limit Value', and 'Start Date', with almost all␣
 ↪values for 'Stop Date', 'Observed Value'
## and 'Observed Date' missing.
```

```
                                                Name    Created   Modified  \
0                  SRA 2021-AAIP-188 RII Missing -82 2021-02-18 2021-03-01
1                     OAK 777 Parking Procedures SRA 2019-08-27 2019-08-27
2                     OAK 777 Parking Procedures SRA 2019-08-27 2019-08-27
3                                Go Around SRA Final 2020-10-30 2020-12-24
4  2020-AAIP-4529 4.2.1 (31) Pitot Covers Install… 2020-12-23 2021-03-01

           Submitted By Plan ID       CurrentStatus
0              Dan Land       0  Interview Complete
1     David Frassinelli     159     Needs Interview
2     David Frassinelli     160     Needs Interview
3           Gary Murphy     171  Interview Complete
4  James (Jim) Chandler     172  Interview Complete
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 426 entries, 0 to 425
Data columns (total 6 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Name           426 non-null    object
 1   Created        426 non-null    datetime64[ns]
 2   Modified       426 non-null    datetime64[ns]
 3   Submitted By   223 non-null    object
 4   Plan ID        233 non-null    object
 5   CurrentStatus  426 non-null    object
dtypes: datetime64[ns](2), object(4)
memory usage: 20.1+ KB
```

```
   Plan ID Source Type Channels                  Status  \
0        2         VDR      NaN  Pending Implementation
1        3         VDR      NaN                Canceled
2        4         VDR      NaN  Pending Implementation
3        5         VDR      NaN  Pending Implementation
4        6         VDR      NaN                  Closed

                   End Date        Created By       Responsible 1  \
0  2021-02-01T06:00:00.000Z  Randy Brinsfield    Randy Brinsfield
1  2020-11-03T06:00:00.000Z     Donald Eddins         Daniel Land
2  2020-12-15T06:00:00.000Z     Hans Kurtzman       Hans Kurtzman
3  2020-12-24T05:00:00.000Z    Michael Dooley  Andrew Halliburton
4  2020-12-09T06:00:00.000Z     Donald Eddins       Donald Eddins

  Responsible 2    Mitigation Type
0           NaN                NaN
1           NaN                NaN
2           NaN  mitigation type 1
3           NaN  mitigation type 1
4           NaN                NaN
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 404 entries, 0 to 403
Data columns (total 9 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   Plan ID          404 non-null    int64
 1   Source Type      404 non-null    object
 2   Channels         251 non-null    object
 3   Status           404 non-null    object
 4   End Date         269 non-null    object
 5   Created By       404 non-null    object
 6   Responsible 1    268 non-null    object
 7   Responsible 2    3 non-null      object
 8   Mitigation Type  156 non-null    object
dtypes: int64(1), object(8)
memory usage: 28.5+ KB
```

```
   Plan ID        Channels              Status Interval  Lower Limit Value  \
0      142    Maint Action  Pending Monitoring  Monthly                1.0
1      159  Audits Channel  Pending Monitoring  Monthly                NaN
2      160  Audits Channel  Pending Monitoring  Monthly                NaN
3      173             NaN                 NaN      NaN                NaN
4      172  Audits Channel  Pending Monitoring  Monthly                NaN

   Upper Limit Value Limit Unit Start Date Stop Date  Observed Value  \
0                4.0     Period        NaN       NaN             NaN
1                1.0      Cycle        NaN       NaN             NaN
2                1.0      Event        NaN       NaN             NaN
3                NaN        NaN        NaN       NaN             NaN
4               50.0  Per Event        NaN       NaN             NaN

  Observed Date
0           NaN
1           NaN
2           NaN
3           NaN
```

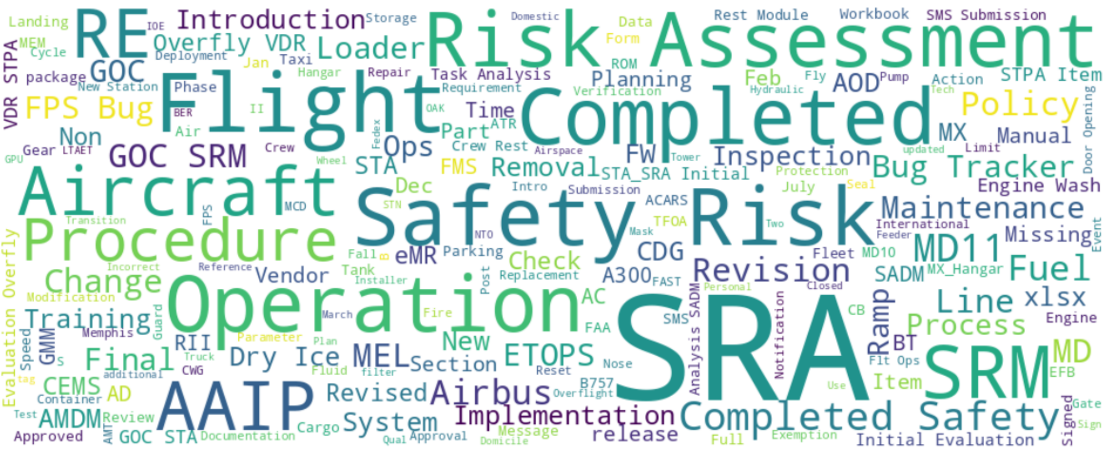
```
4          NaN
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 391 entries, 0 to 390
Data columns (total 11 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   Plan ID            391 non-null    int64
 1   Channels           387 non-null    object
 2   Status             387 non-null    object
 3   Interval           387 non-null    object
 4   Lower Limit Value  102 non-null    float64
 5   Upper Limit Value  224 non-null    float64
 6   Limit Unit         372 non-null    object
 7   Start Date         277 non-null    object
 8   Stop Date          65 non-null     object
 9   Observed Value     3 non-null      float64
 10  Observed Date      6 non-null      object
dtypes: float64(3), int64(1), object(7)
memory usage: 33.7+ KB
```

1.2 Visualizing First Sheet/Dataset

[193]:

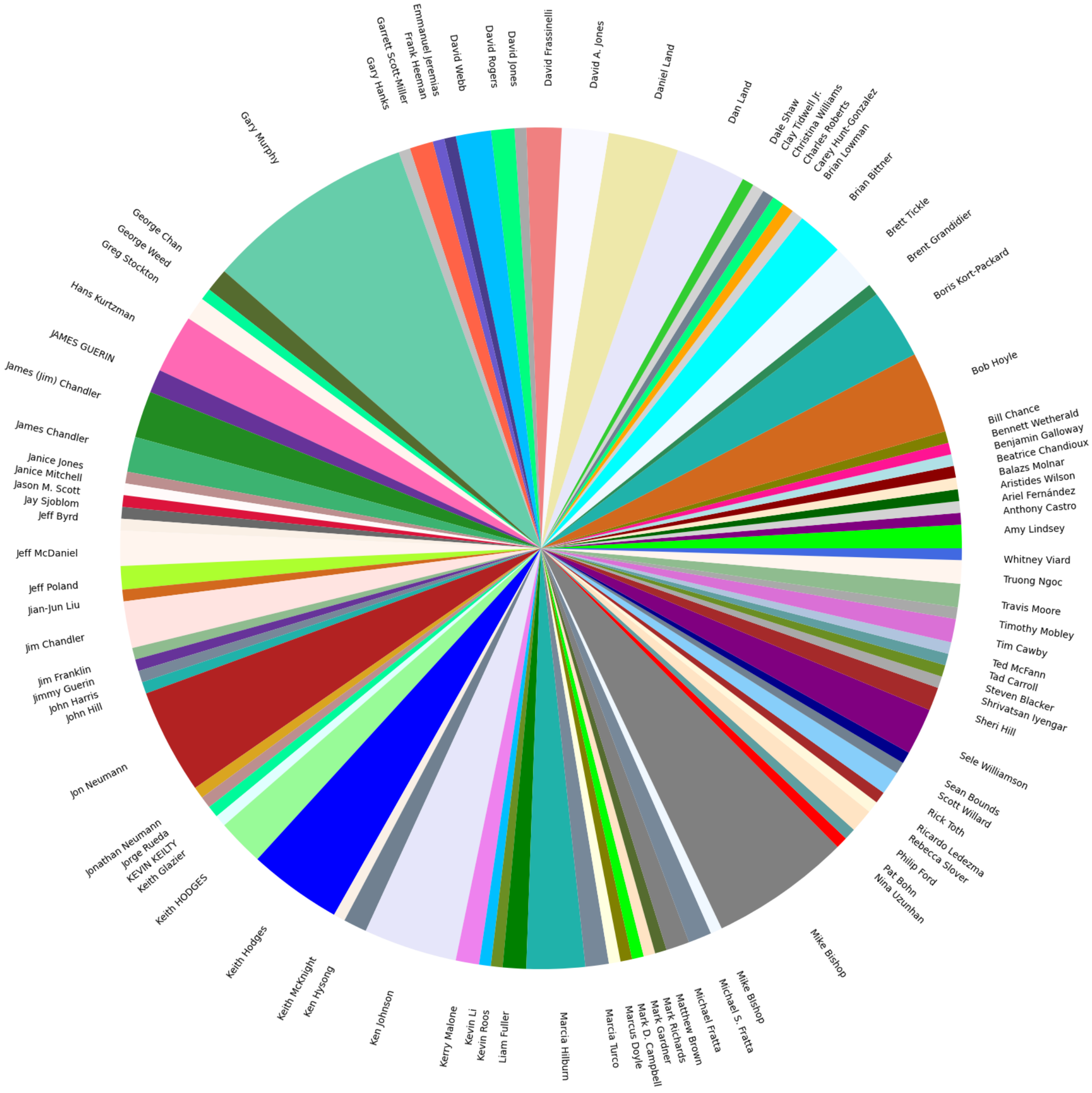
```
random.seed(4825)

## Word-cloud based on report name to get a sense of the theme of reports
df1['Name'] = df1['Name'].astype('str')
text = " ".join(i for i in df1.Name)
stopwords = set(STOPWORDS)
wordcloud = WordCloud(stopwords=stopwords, background_color="white",␣
 ↪width=1000, height=400).generate(text)
plt.figure( figsize=(15,10))
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.show()
```



```
[194]: ## Pie chart of unique report submitters

       df = df1.groupby(['Submitted By']).size()
       print(len(df)) # 96 unique value, which means that all the reports came from␣
        ↪only 96 sources
       colors = random.choices(list(mcolors.CSS4_COLORS.values()),k = 96)
       df.plot.pie(y='Submitted By', figsize=(20, 20), rotatelabels=True,␣
        ↪colors=colors)
```

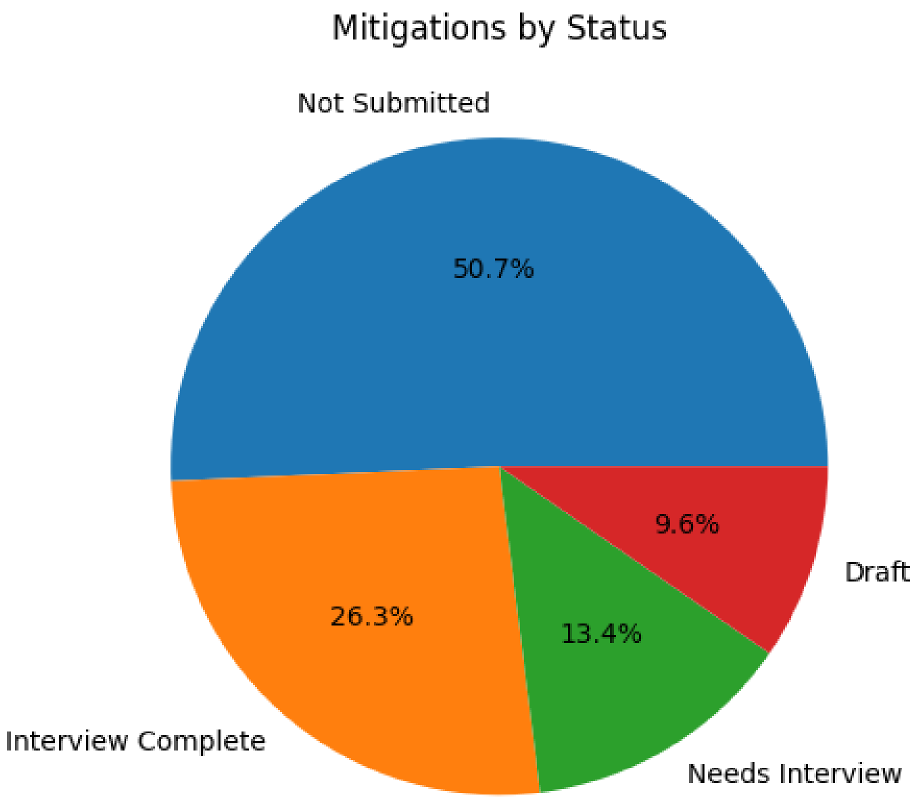
```
96
```

```
[194]: <AxesSubplot: >
```



[195]:

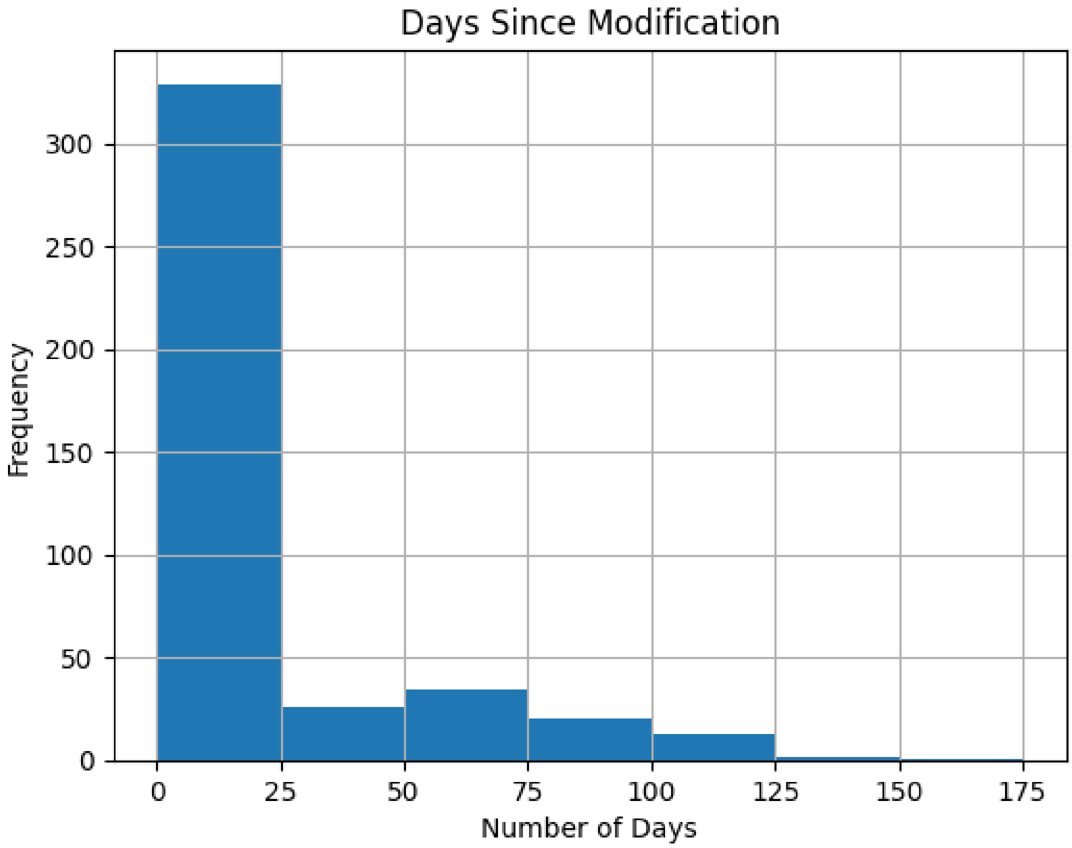
```
## Distribution of mitigations by their current status

current_status_counts = pd.DataFrame(df1['CurrentStatus'].value_counts().
 ↪reset_index()) # Creating separate df for plotting
plt.pie(data=current_status_counts, x='CurrentStatus', labels='index',␣
 ↪autopct='%.1f%%')
plt.title('Mitigations by Status')
plt.tight_layout()

# We notice that the majority of mitigation reports are not submitted
```



[196]:
```
## Creating year-partitioned datasets for first sheet for use later
df1['Created'] = pd.to_datetime(df1['Created'], format='%Y-%m-%d')
df1['Modified'] = pd.to_datetime(df1['Modified'], format='%Y-%m-%d')
df1_2019 = df1.loc[(df1['Created'] >= '2019-01-01') & (df1['Created'] <=␣
  ↪'2019-12-31')]
df1_2020 = df1.loc[(df1['Created'] >= '2020-01-01') & (df1['Created'] <=␣
  ↪'2020-12-31')]
df1_2021 = df1.loc[(df1['Created'] >= '2021-01-01') & (df1['Created'] <=␣
  ↪'2021-12-31')]
```

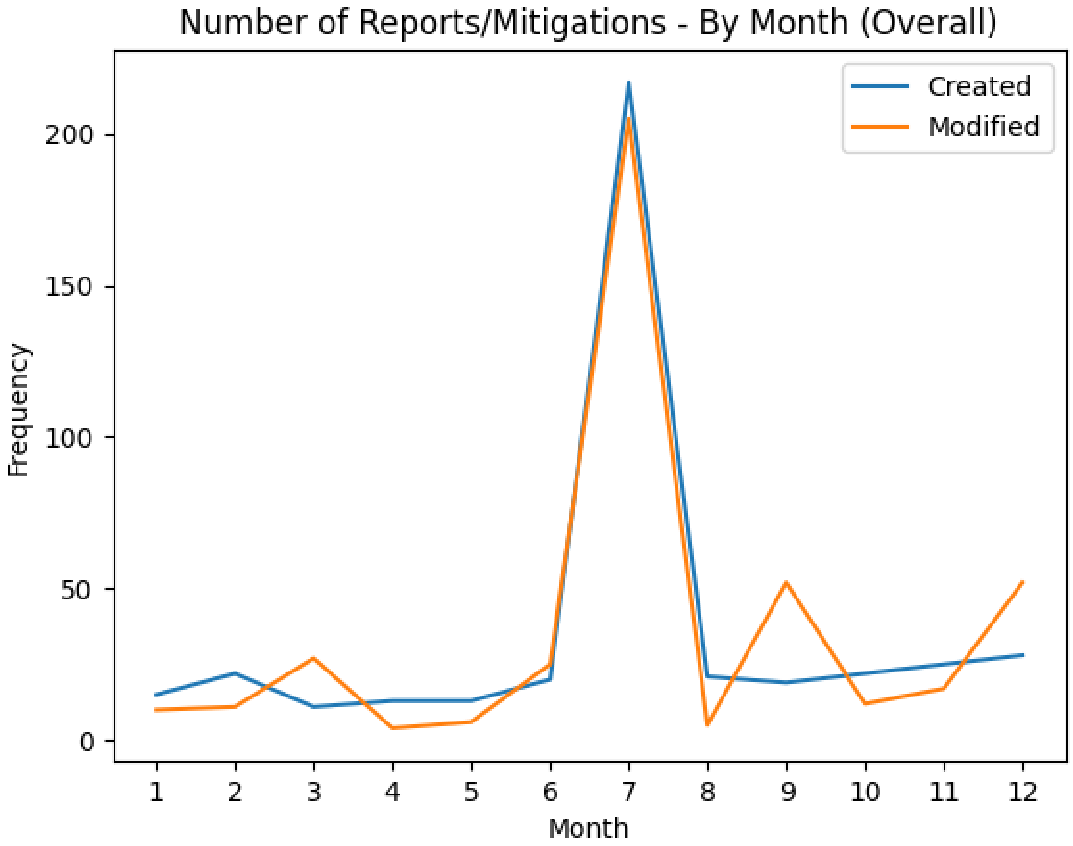
[197]:
```
## Days since modification histogram
df1['Created'] = pd.to_datetime(df1['Created'], format='%Y-%m-%d')
df1['days_modified'] = df1['Modified'] - df1['Created'] # New feature - days␣
  ↪passed between report creation and modification
df1['days_modified'].describe() # On average, reports were modified in 17 days,␣
  ↪earliest modification occured on the same
# day, latest modification occured 182 days later
df1['days_modified'].dt.days.hist(bins=range(0, 182, 25))
plt.title('Days Since Modification')
plt.xlabel('Number of Days')
plt.ylabel('Frequency')
```

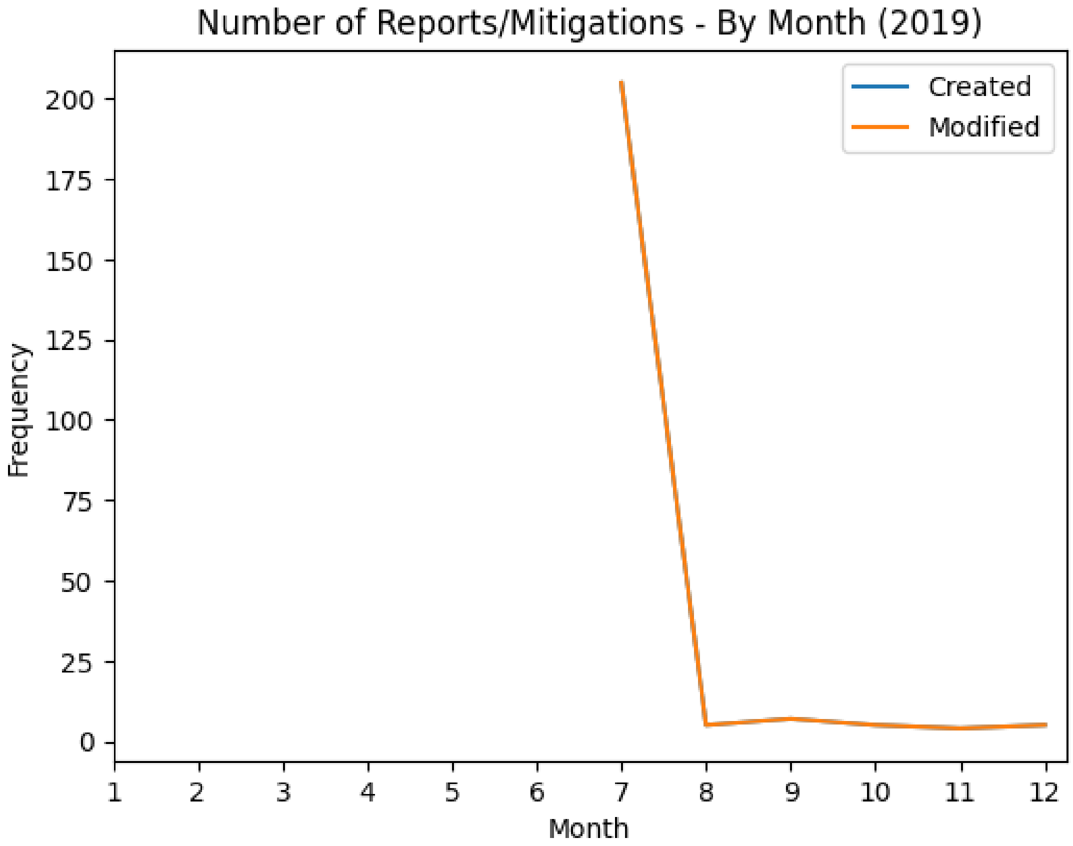
[197]: Text(0, 0.5, 'Frequency')

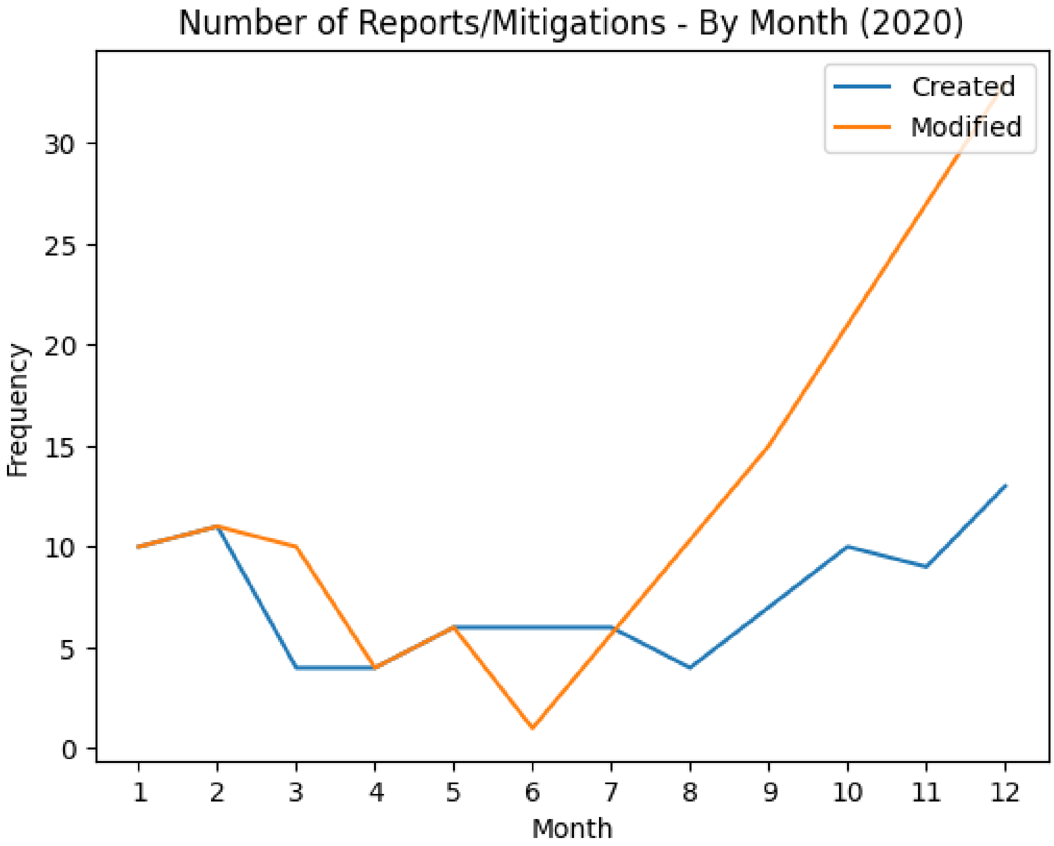


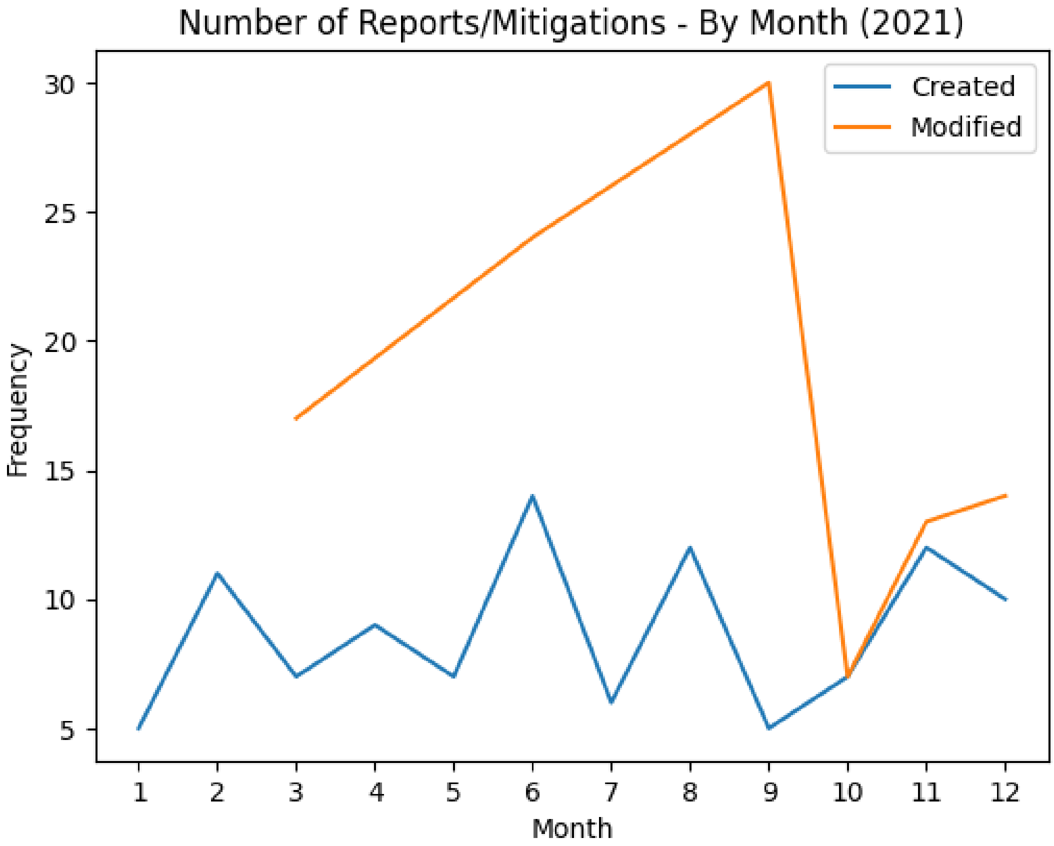
[198]:
```
## Report creations and modifications by month (sorted by year)
# Overall for full dataset
df1['Created'].dt.month.value_counts().sort_index().plot(use_index=True,␣
 ↪label="Created") # Spike in creations in the month of July
df1['Modified'].dt.month.value_counts().sort_index().plot(use_index=True,␣
 ↪label="Modified") # Spike in modifications in the month of July??
plt.xticks(range(1, 13))
plt.title('Number of Reports/Mitigations - By Month (Overall)')
plt.xlabel('Month')
plt.ylabel('Frequency')
plt.legend(loc="upper right")
plt.show()

# For 2019
```

```
df1_2019['Created'].dt.month.value_counts().sort_index().plot(use_index=True,␣
 ↪label="Created") # Spike in creations in the month of July
df1_2019['Modified'].dt.month.value_counts().sort_index().plot(use_index=True,␣
 ↪label="Modified") # Spike in modifications in the month of July??
plt.xticks(range(1, 13))
plt.title('Number of Reports/Mitigations - By Month (2019)')
plt.xlabel('Month')
plt.ylabel('Frequency')
plt.legend(loc="upper right")
plt.show()

# For 2020
df1_2020['Created'].dt.month.value_counts().sort_index().plot(use_index=True,␣
 ↪label="Created") # Spike in creations in the month of July
df1_2020['Modified'].dt.month.value_counts().sort_index().plot(use_index=True,␣
 ↪label="Modified") # Spike in modifications in the month of July??
plt.xticks(range(1, 13))
plt.title('Number of Reports/Mitigations - By Month (2020)')
plt.xlabel('Month')
plt.ylabel('Frequency')
plt.legend(loc="upper right")
plt.show()

# For 2021
df1_2021['Created'].dt.month.value_counts().sort_index().plot(use_index=True,␣
 ↪label="Created") # Spike in creations in the month of July
df1_2021['Modified'].dt.month.value_counts().sort_index().plot(use_index=True,␣
 ↪label="Modified") # Spike in modifications in the month of July??
plt.xticks(range(1, 13))
plt.title('Number of Reports/Mitigations - By Month (2021)')
plt.xlabel('Month')
plt.ylabel('Frequency')
plt.legend(loc="upper right")
plt.show()

# There is a difference in report/mitigation creation between 2020 and 2021, as␣
 ↪the year progresses
```


Number of Reports/Mitigations - By Month (Overall)
Created
Modified
Frequency
0
50
100
150
200
1
2
3
4
5
6
7
8
9
10
11
12
Month


Number of Reports/Mitigations - By Month (2019)
Created
Modified
Frequency
200
175
150
125
100
75
50
25
0
1
2
3
4
5
6
7
8
9
10
11
12
Month


Number of Reports/Mitigations - By Month (2020)
Created
Modified
Frequency
0
5
10
15
20
25
30
Month
1
2
3
4
5
6
7
8
9
10
11
12

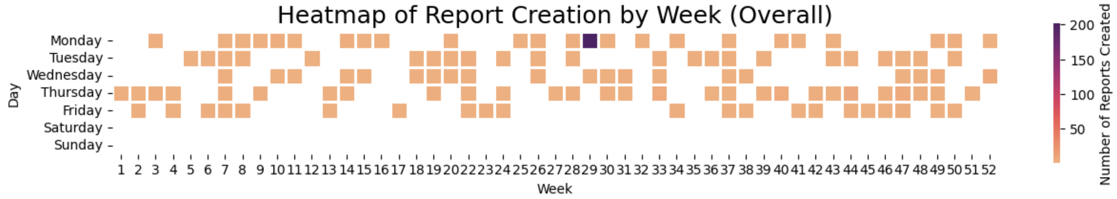


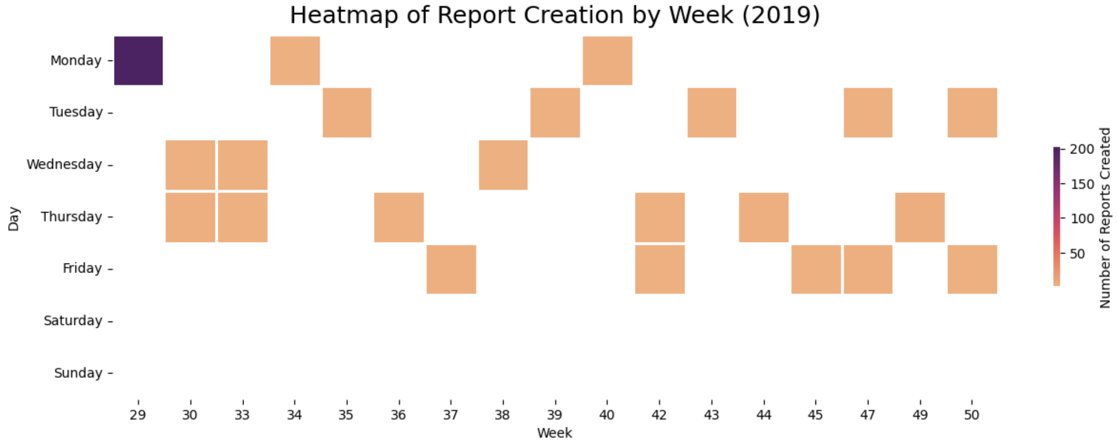
[199]:

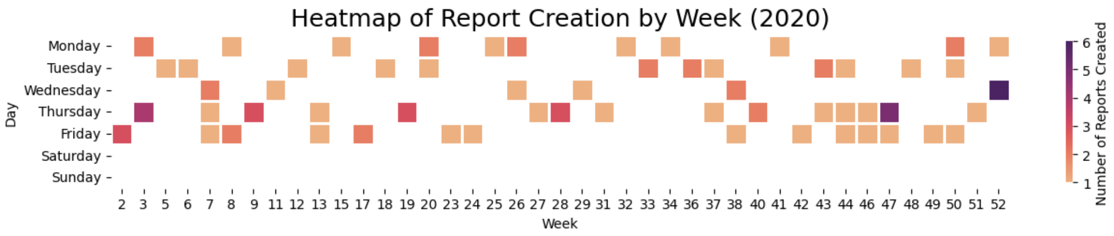
```
## Heatmap to see which days were the most active for reporting (To visually␣
 ↪ascertain pattern for report creation
## over days, which days are busier?)

# Overall for full dataset
days = ['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday',␣
 ↪'Sunday']
df1['creation_time_week'] = df1['Created'].dt.isocalendar().week
df1['creation_time_day_name'] = df1['Created'].dt.day_name()

df1_hm = pd.pivot_table(df1[['creation_time_week', 'creation_time_day_name']],
                              index=['creation_time_week',␣
 ↪'creation_time_day_name'], aggfunc='size')
df1_hm = df1_hm.unstack(level=1)
df1_hm = df1_hm.reindex(columns=days)
df1_hm = df1_hm.T

f, ax = plt.subplots(figsize=(15, 19))
ax = sns.heatmap(df1_hm, square=True, cmap='flare', linewidths=.9, ax=ax,
                cbar_kws={"shrink":.1, "label": "Number of Reports Created"})
ax.axes.set_title("Heatmap of Report Creation by Week (Overall)", fontsize=18,␣
 ↪y=1.01)
ax.set(xlabel='Week', ylabel='Day')

# For 2019
df1_2019['creation_time_week'] = df1_2019['Created'].dt.isocalendar().week
df1_2019['creation_time_day_name'] = df1_2019['Created'].dt.day_name()

df1_hm = pd.pivot_table(df1_2019[['creation_time_week',␣
 ↪'creation_time_day_name']],
                              index=['creation_time_week',␣
 ↪'creation_time_day_name'], aggfunc='size')
df1_hm = df1_hm.unstack(level=1)
df1_hm = df1_hm.reindex(columns=days)
df1_hm = df1_hm.T

f, ax = plt.subplots(figsize=(15, 19))
ax = sns.heatmap(df1_hm, square=True, cmap='flare', linewidths=.9, ax=ax,
                cbar_kws={"shrink":.1, "label": "Number of Reports Created"})
ax.axes.set_title("Heatmap of Report Creation by Week (2019)", fontsize=18, y=1.
 ↪01)
ax.set(xlabel='Week', ylabel='Day')

# For 2020
df1_2020['creation_time_week'] = df1_2020['Created'].dt.isocalendar().week
df1_2020['creation_time_day_name'] = df1_2020['Created'].dt.day_name()

df1_hm = pd.pivot_table(df1_2020[['creation_time_week',␣
 ↪'creation_time_day_name']],
                              index=['creation_time_week',␣
 ↪'creation_time_day_name'], aggfunc='size')
df1_hm = df1_hm.unstack(level=1)
df1_hm = df1_hm.reindex(columns=days)
df1_hm = df1_hm.T

f, ax = plt.subplots(figsize=(15, 19))
ax = sns.heatmap(df1_hm, square=True, cmap='flare', linewidths=.9, ax=ax,
                cbar_kws={"shrink":.1, "label": "Number of Reports Created"})
ax.axes.set_title("Heatmap of Report Creation by Week (2020)", fontsize=18, y=1.
 ↪01)
ax.set(xlabel='Week', ylabel='Day')

# For 2021
df1_2021['creation_time_week'] = df1_2021['Created'].dt.isocalendar().week
df1_2021['creation_time_day_name'] = df1_2021['Created'].dt.day_name()
```

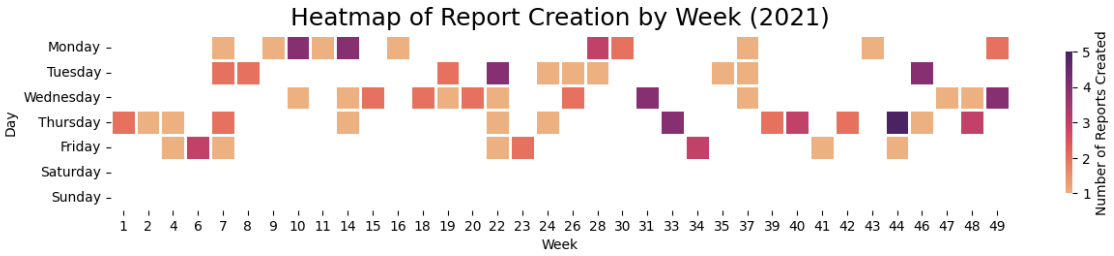
```
df1_hm = pd.pivot_table(df1_2021[['creation_time_week',␣
 ↪'creation_time_day_name']],
                              index=['creation_time_week',␣
 ↪'creation_time_day_name'], aggfunc='size')
df1_hm = df1_hm.unstack(level=1)
df1_hm = df1_hm.reindex(columns=days)
df1_hm = df1_hm.T

f, ax = plt.subplots(figsize=(15, 19))
ax = sns.heatmap(df1_hm, square=True, cmap='flare', linewidths=.9, ax=ax,
                cbar_kws={"shrink":.1, "label": "Number of Reports Created"})
ax.axes.set_title("Heatmap of Report Creation by Week (2021)", fontsize=18, y=1.
 ↪01)
ax.set(xlabel='Week', ylabel='Day')
```

```
[199]: [Text(0.5, 820.8055555555555, 'Week'), Text(158.22222222222223, 0.5, 'Day')]
```









1.3 Visualizing Second Sheet/Dataset

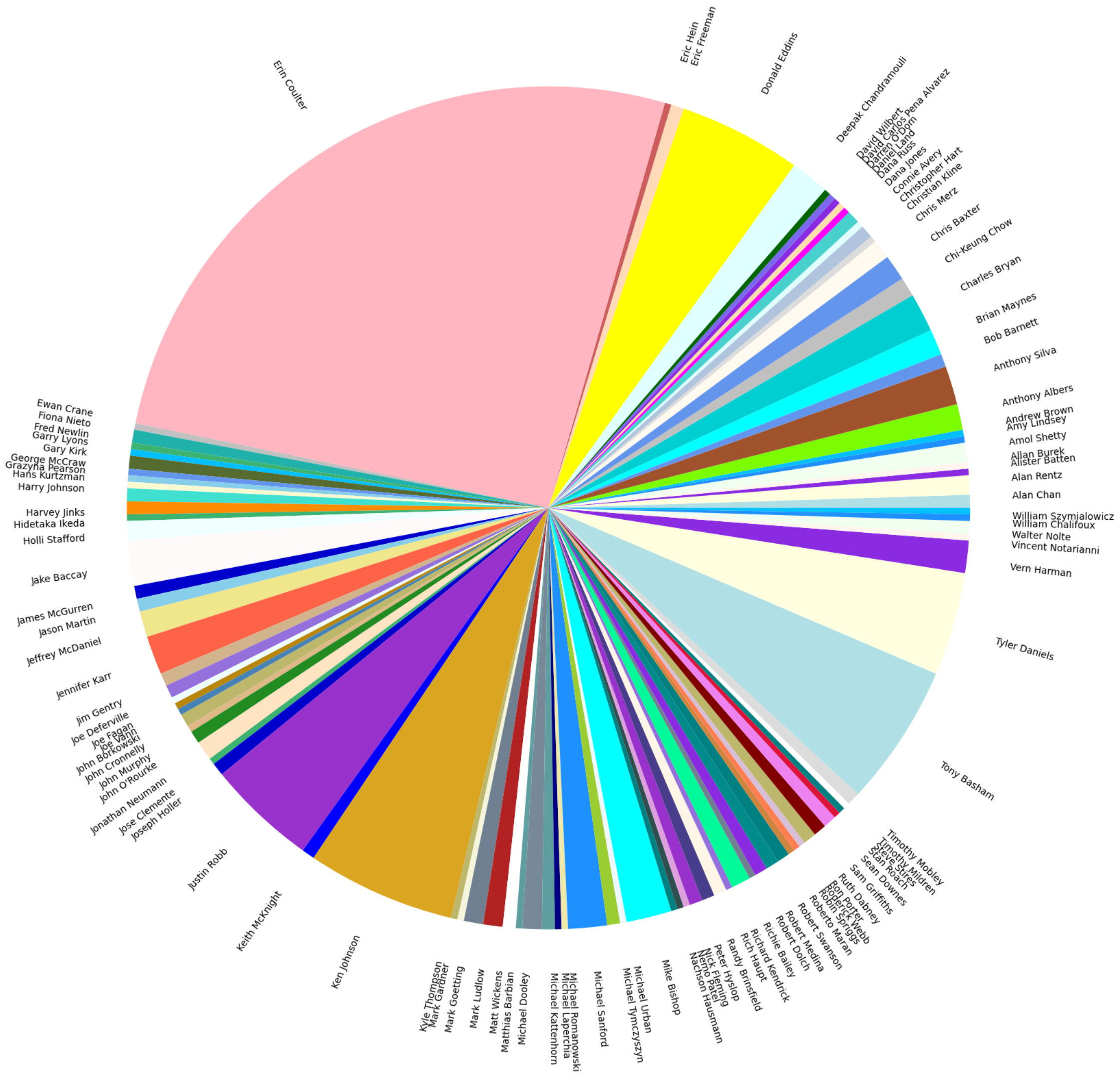
[200]:

```
## Pie chart of unique report submitters
df = df2.groupby(['Created By']).size()
print(len(df)) # 103 unique value, which means that all the reports came from only 103 sources, of which Erin Coulter
# has created most tracking reports
colors = random.choices(list(mcolors.CSS4_COLORS.values()),k = 96)
df.plot.pie(y='Submitted By', figsize=(20, 20), rotatelabels=True, colors=colors)
```

```
103
```

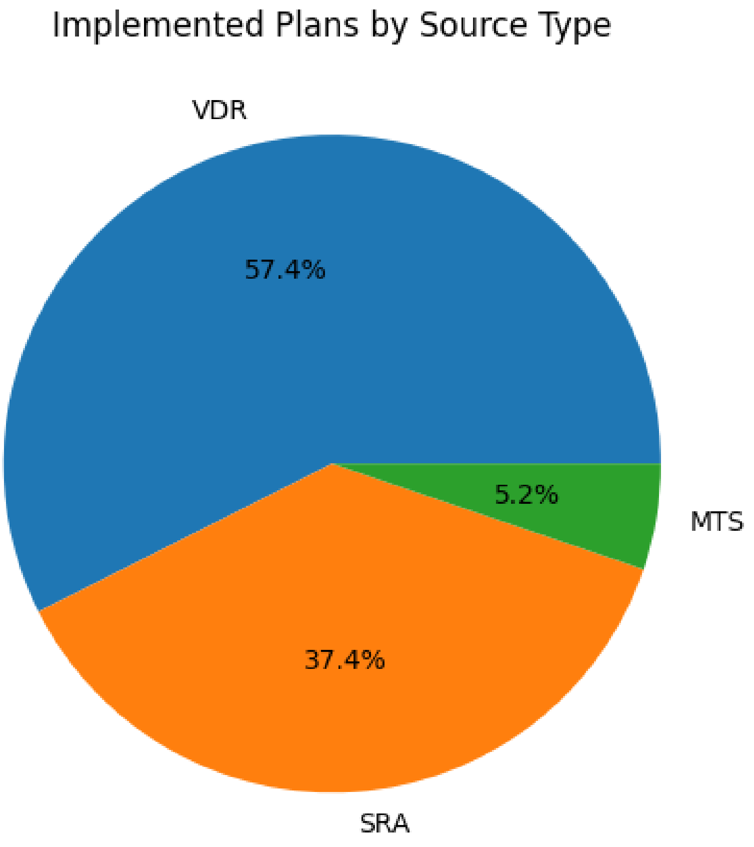
[200]:

```
<AxesSubplot: >
```



[201]:
```
# Checking distribution of Source Type for implemented plans

##
source_type_counts = pd.DataFrame(df2['Source Type'].value_counts().
 ↪reset_index()) # Creating separate df for plotting
display(source_type_counts)
plt.pie(data=source_type_counts, x='Source Type', labels='index', autopct='%.
 ↪1f%%')
plt.title('Implemented Plans by Source Type')
plt.tight_layout()

# We can see that the majority of implemented plans have VDR as a source,␣
 ↪followed by SRA as the second biggest source,
# and finally, MTS as the source for the remaining plans
```

```
  index  Source Type
0   VDR          232
1   SRA          151
2   MTS           21
```



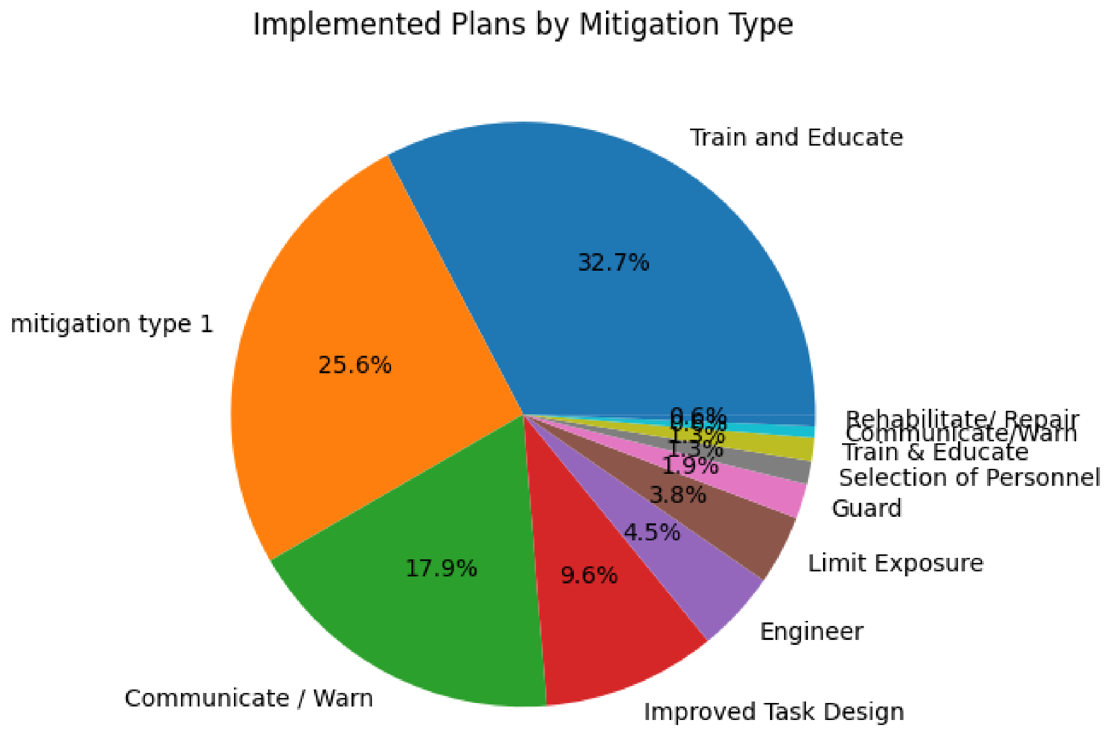
[202]:

```
## Distribution of mitigations by Mitigation Type

mitigation_type_counts = pd.DataFrame(df2['Mitigation Type'].value_counts().
 ↪reset_index()) # Creating separate df for plotting
display(mitigation_type_counts)
plt.pie(data=mitigation_type_counts, x='Mitigation Type', labels='index',␣
 ↪autopct='%.1f%%')
plt.title('Implemented Plans by Mitigation Type')
plt.tight_layout()
plt.show()
```

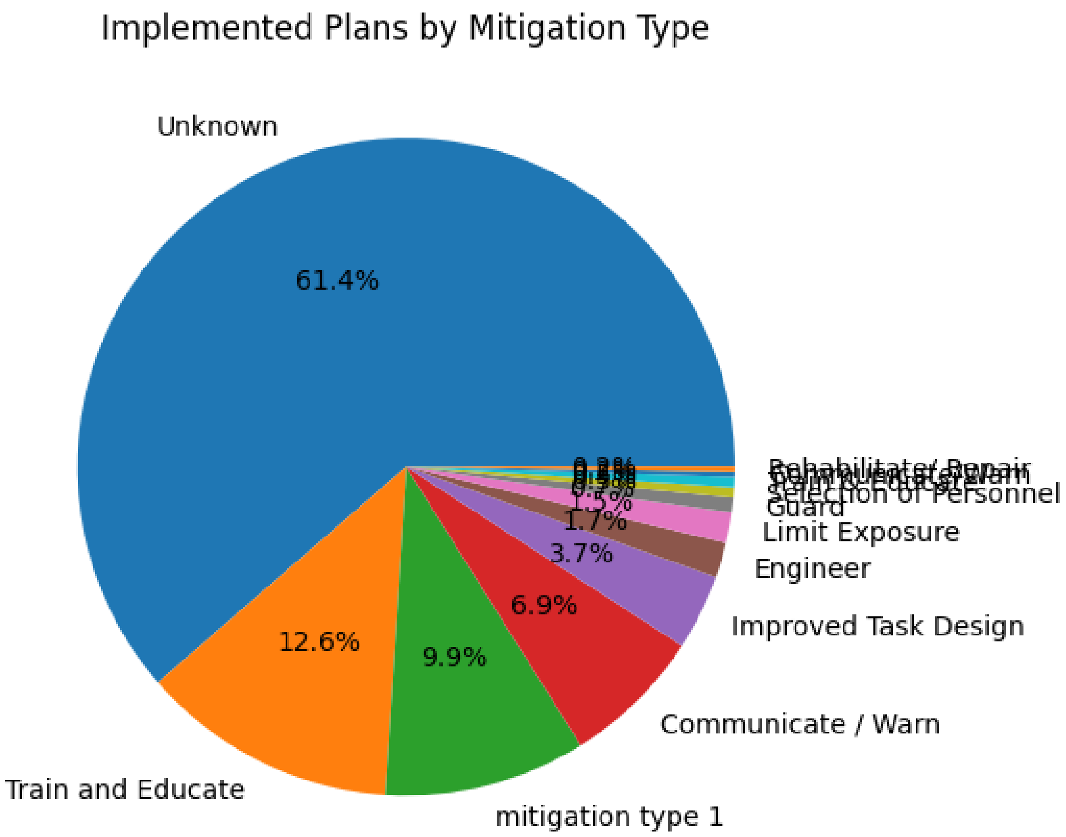
```
# Majority (not absolute) of mitigation plan types are 'Train and Educate',␣
 ↪followed by 'mitigation type 1', and
# 'Communicate / Warn' at third place. Only one mitigation plan type involves␣
 ↪rehabilitation and repair but we have
# to keep in mind that we only have 156 observations for mitigation type of the␣
 ↪404 entries in the dataset, but we
# can use these proportions to estimate the others.

# We can impute the missing values with 'Unknown'
df2['Mitigation Type'] = df2['Mitigation Type'].astype(object)
df2['Mitigation Type'].fillna('Unknown', inplace=True)

mitigation_type_counts = pd.DataFrame(df2['Mitigation Type'].value_counts().
 ↪reset_index()) # Creating separate df for plotting
display(mitigation_type_counts)
plt.pie(data=mitigation_type_counts, x='Mitigation Type', labels='index',␣
 ↪autopct='%.1f%%')
plt.title('Implemented Plans by Mitigation Type')
plt.tight_layout()
plt.show()
# Now the vast majority of the mitigations are of an unknown type

# Filling in missing values with most commonly occuring category (mode)
df2 = pd.read_excel(xls, "Impl")
df2 = df2.apply(lambda x: x.fillna(x.value_counts().index[0]))

mitigation_type_counts = pd.DataFrame(df2['Mitigation Type'].value_counts().
 ↪reset_index()) # Creating separate df for plotting
display(mitigation_type_counts)
plt.pie(data=mitigation_type_counts, x='Mitigation Type', labels='index',␣
 ↪autopct='%.1f%%')
plt.title('Implemented Plans by Mitigation Type')
plt.tight_layout()
plt.show()
# Now the vast majority of the mitigations are 'Train and Educate'
```

```
                      index  Mitigation Type
0          Train and Educate               51
1          mitigation type 1               40
2         Communicate / Warn               28
3      Improved Task Design               15
4                   Engineer                7
5             Limit Exposure                6
6                      Guard                3
7    Selection of Personnel                2
8           Train & Educate                2
9         Communicate/Warn                 1
```

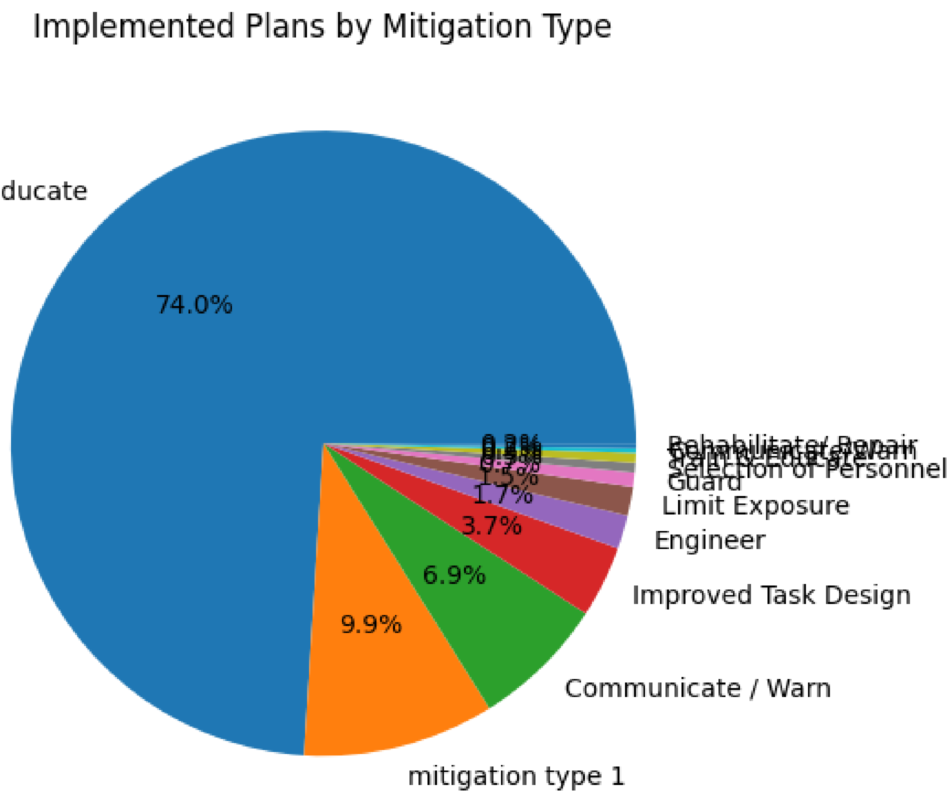
```
10    Rehabilitate/ Repair                 1
```



```
                   index  Mitigation Type
0                Unknown              248
1        Train and Educate             51
2        mitigation type 1             40
3       Communicate / Warn             28
4     Improved Task Design             15
5                 Engineer              7
6           Limit Exposure              6
7                    Guard              3
8   Selection of Personnel              2
9          Train & Educate              2
10        Communicate/Warn              1
11    Rehabilitate/ Repair              1
```


Implemented Plans by Mitigation Type

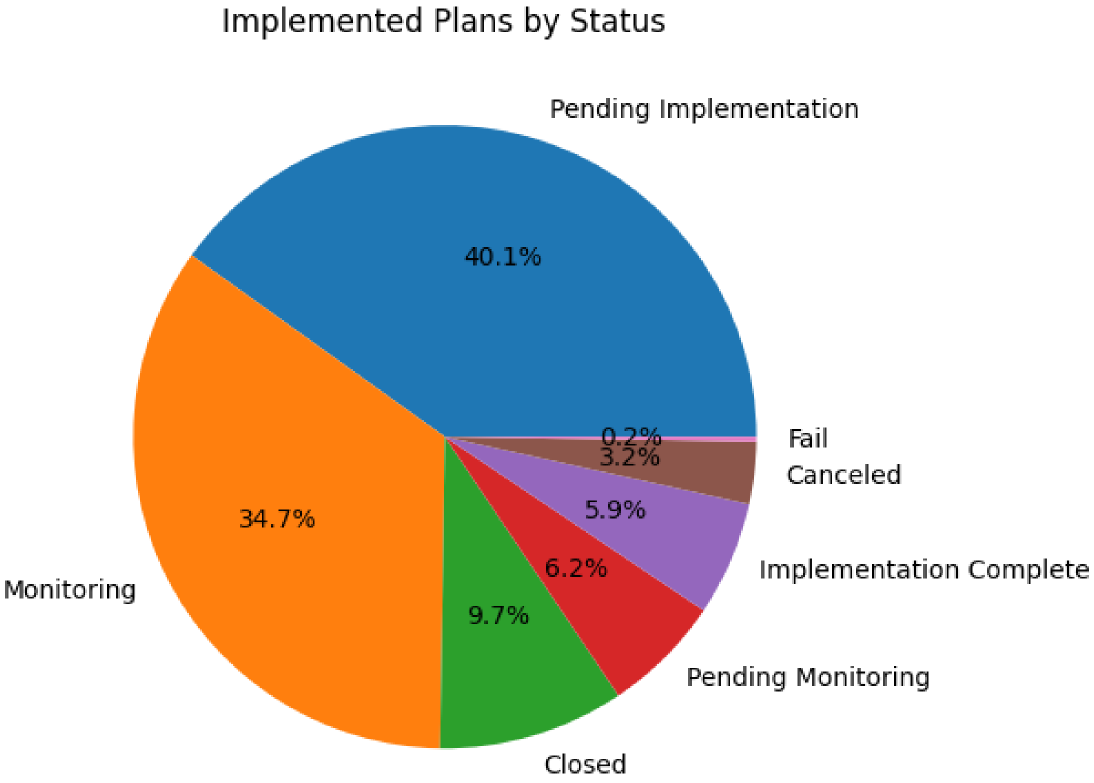
```
                   index  Mitigation Type
0        Train and Educate              299
1        mitigation type 1               40
2       Communicate / Warn               28
3      Improved Task Design              15
4                 Engineer                7
5           Limit Exposure                6
6                    Guard                3
7   Selection of Personnel                2
8          Train & Educate                2
9         Communicate/Warn                1
10    Rehabilitate/ Repair                1
```



```
[203]: ## Distribution of mitigations by Status
df2 = pd.read_excel(xls, "Impl") # Re-loading data to reset previous␣
 ↪missin-value imputation

status_counts = pd.DataFrame(df2['Status'].value_counts().reset_index()) #␣
 ↪Creating separate df for plotting
display(status_counts)
plt.pie(data=status_counts, x='Status', labels='index', autopct='%.1f%%')
plt.title('Implemented Plans by Status')
plt.tight_layout()
plt.show()

# Looks like most implementation plans are pending implementation, followed in␣
 ↪frequency by current plans being
# monitored
```

```
                    index  Status
0  Pending Implementation     162
1              Monitoring     140
2                  Closed      39
```

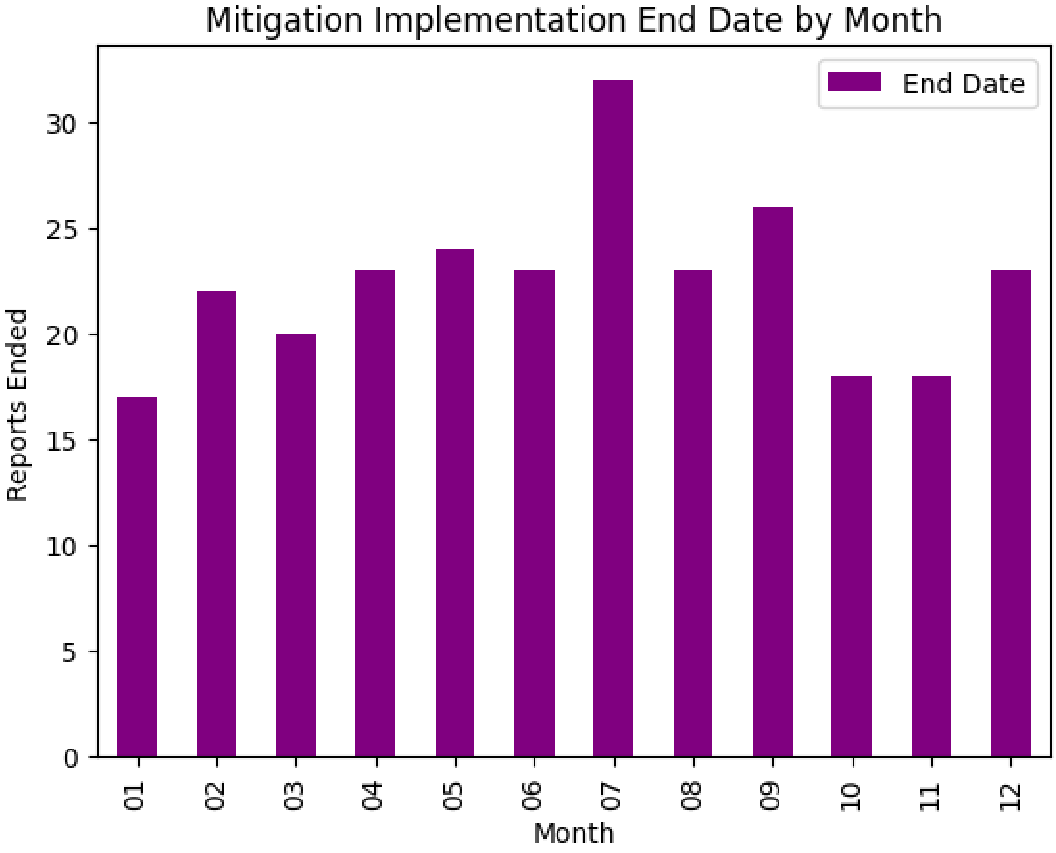
```
3        Pending Monitoring       25
4   Implementation Complete       24
5                  Canceled       13
6                      Fail        1
```



[204]:

```
# Bar chart to get a sense of end-dates


df2['End Date'] = pd.to_datetime(df2['End Date'], format='%Y-%m-%d')
df2_ed_months = pd.DataFrame(df2['End Date'].dt.strftime('%m').value_counts().
  ↪sort_index())

df2_ed_months.plot(kind='bar', color='purple')
plt.title('Mitigation Implementation End Date by Month')
plt.xlabel('Month')
plt.ylabel('Reports Ended')
plt.legend(loc="upper right")
plt.show()
```

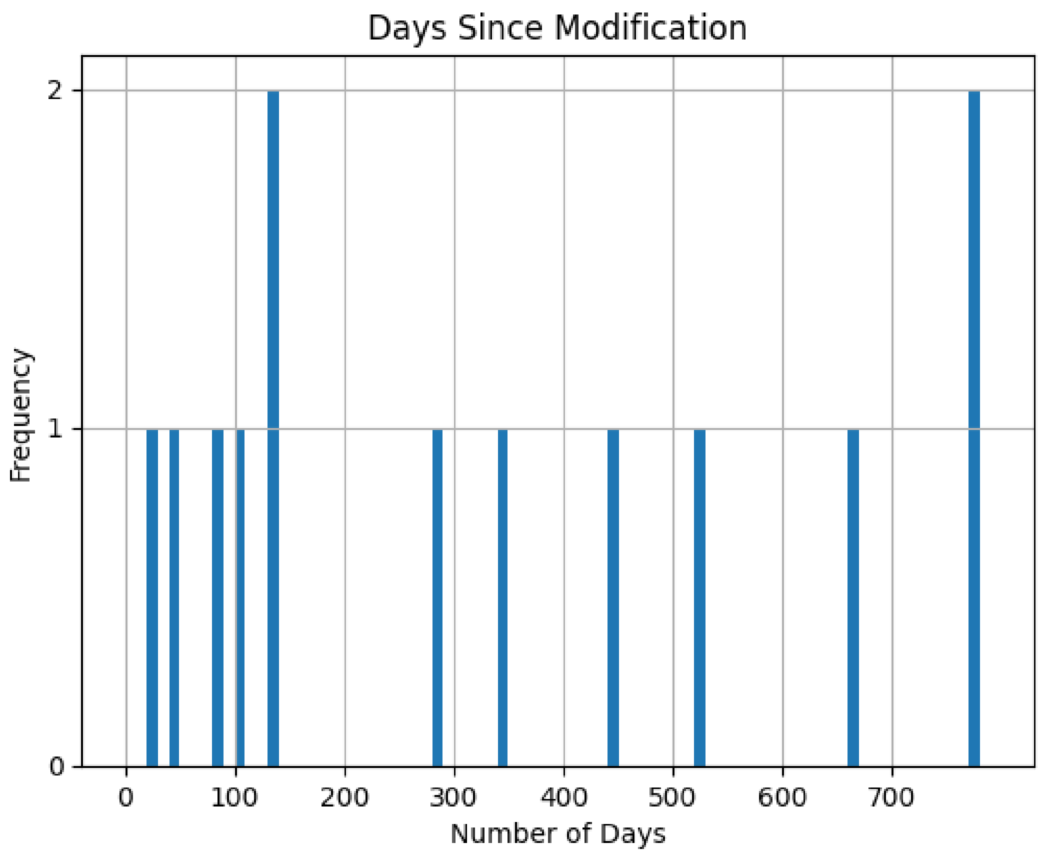
```
# Most mitigations were ended, by amount, in July, but seem pretty even across␣
 ↪the year
```



[205]:

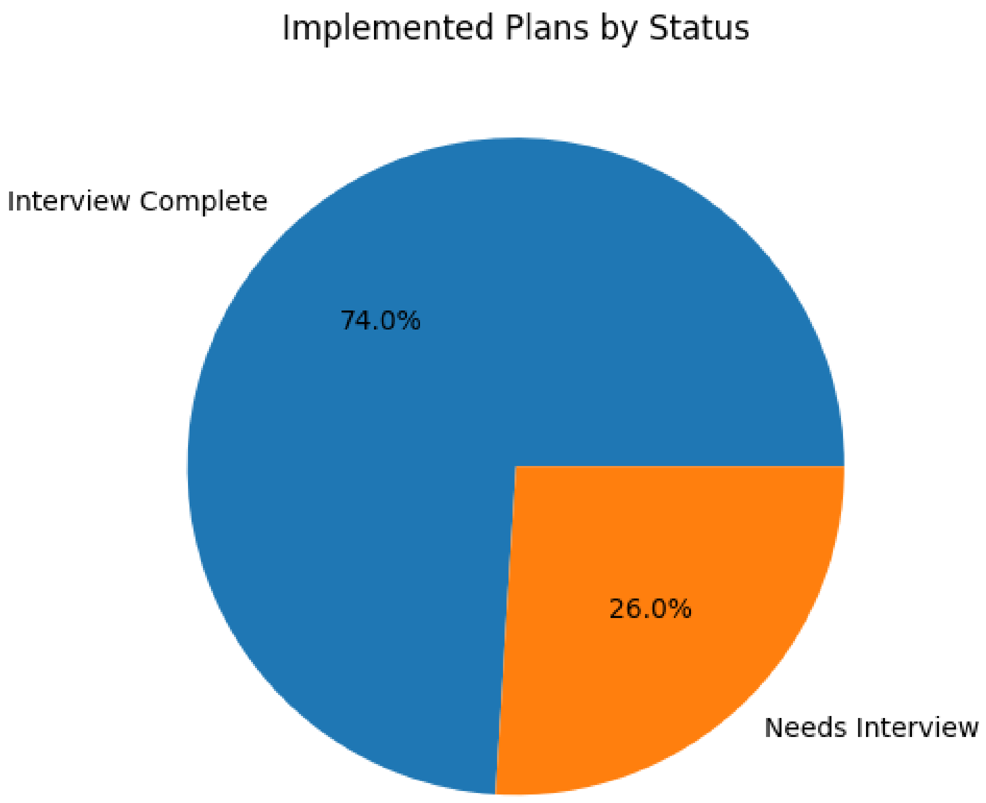
```
# Combining datasets/sheets on common Plan ID (Source and Impl)

source_impl_join =pd.merge(df1, df2, on='Plan ID', how='inner')
source_impl_join.head()
source_impl_join['crt_end_diff'] = source_impl_join['End Date'].dt.date -␣
 ↪source_impl_join['Created'].dt.date # New
# feature that calulates the days passed between ending and creation of a plan
source_impl_join['crt_end_diff'].dt.days.hist(bins=range(0, 800, 10))
plt.xticks(range(0, 800, 100))
plt.yticks(range(0, 3, 1))
plt.title('Days Since Modification')
plt.xlabel('Number of Days')
plt.ylabel('Frequency')

# Plot is sparse due to many missing values for End Date
source_impl_join.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 127 entries, 0 to 126
Data columns (total 19 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   Name                    127 non-null    object
 1   Created                 127 non-null    datetime64[ns]
 2   Modified                127 non-null    datetime64[ns]
 3   Submitted By            124 non-null    object
 4   Plan ID                 127 non-null    object
 5   CurrentStatus           127 non-null    object
 6   days_modified           127 non-null    timedelta64[ns]
 7   creation_time_week      127 non-null    UInt32
 8   creation_time_day_name  127 non-null    object
 9   SN                      127 non-null    int64
 10  Source Type             127 non-null    object
 11  Channels                127 non-null    object
 12  Status                  127 non-null    object
 13  End Date                13 non-null     datetime64[ns, UTC]
 14  Created By              127 non-null    object
 15  Responsible 1           12 non-null     object
 16  Responsible 2           0 non-null      object
 17  Mitigation Type         12 non-null     object
 18  crt_end_diff            13 non-null     timedelta64[ns]
dtypes: UInt32(1), datetime64[ns, UTC](1), datetime64[ns](2), int64(1),
object(12), timedelta64[ns](2)
memory usage: 19.5+ KB
```



[206]:
```
# Checking the current status of plans being monitored

##
current_status_counts_2 = pd.DataFrame(source_impl_join['CurrentStatus'].
 ↪value_counts().reset_index()) # Creating separate df for plotting
display(current_status_counts_2)
plt.pie(data=current_status_counts_2, x='CurrentStatus', labels='index',␣
 ↪autopct='%.1f%%')
plt.title('Implemented Plans by Status')
plt.tight_layout()

# We notice that the vast majority of the interviews for implemented plans is␣
 ↪complete
```

```
                index  CurrentStatus
0  Interview Complete             94
1     Needs Interview             33
```



1.4 Visualizing Third Sheet/Dataset

[207]:

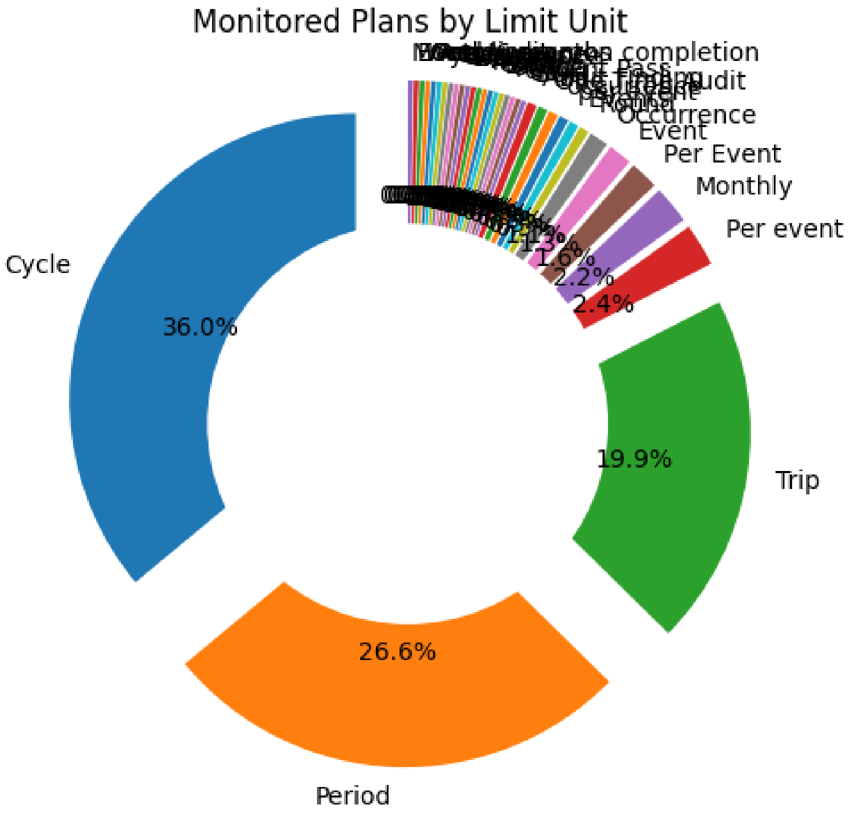
```python
# Alluvial flow diagram for Interval and Status

import holoviews as hv
hv.extension('bokeh')

df3_alluvial = df3.iloc[:,[2, 3, 6]] # Need to subset for visualization
df3_alluvial.head()
df3_alluvial = df3_alluvial.apply(lambda x: x.fillna(x.value_counts().
 ↪index[0])) # Filling missing values
alluvial_df = pd.DataFrame(df3_alluvial['Status'].
 ↪groupby(df3_alluvial['Interval']).value_counts())
alluvial_df.columns = ['Counts']
alluvial_df = alluvial_df.reset_index()
hv.Sankey(alluvial_df)
```

```
# Most monthly interval mitigations are being monitored, whereas almost all␣
 ↪daily and weekly interval mitigations
# are pending
```

[207]:
```
:Sankey   [Interval,Status]   (Counts)
```

[208]:
```
# Combining datasets/sheets on common Plan ID (Impl and Monitoring)

impl_monitoring_join =pd.merge(df2, df3, on='Plan ID', how='inner')
impl_monitoring_join.info() # Looks like only 391 mitigation plans are being␣
 ↪monitored
impl_monitoring_join = impl_monitoring_join.drop('SN', 1) # Dropping SN column␣
 ↪since data is already indexed

# Visualizing the distribution of Limit Unit

fig1, ax1 = plt.subplots()
explode = []
for i in range(len(limit_units_counts)):
    explode.append(.2)

ax1.pie(limit_units_counts['Limit Unit'], labels=limit_units_counts['index'],␣
 ↪autopct='%1.1f%%', startangle=90,
       explode = explode)
centre_circle = plt.Circle((0,0),0.70,fc='white')
fig = plt.gcf()
fig.gca().add_artist(centre_circle)
ax1.axis('equal')
plt.title('Monitored Plans by Limit Unit')
plt.tight_layout()
plt.show()

# There appears to be many types of limit units which can be possibly␣
 ↪consolidated to a single type
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 391 entries, 0 to 390
Data columns (total 20 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   SN                  391 non-null    int64
 1   Plan ID             391 non-null    int64
 2   Source Type         391 non-null    object
 3   Channels_x          387 non-null    object
 4   Status_x            391 non-null    object
 5   End Date            138 non-null    datetime64[ns, UTC]
 6   Created By          391 non-null    object
 7   Responsible 1      137 non-null    object
 8   Responsible 2      3 non-null      object
 9   Mitigation Type    133 non-null    object
 10  Channels_y         387 non-null    object
 11  Status_y           387 non-null    object
 12  Interval           387 non-null    object
 13  Lower Limit Value  102 non-null    float64
 14  Upper Limit Value  224 non-null    float64
 15  Limit Unit         372 non-null    object
 16  Start Date         277 non-null    object
 17  Stop Date          65 non-null     object
 18  Observed Value     3 non-null      float64
 19  Observed Date      6 non-null      object
dtypes: datetime64[ns, UTC](1), float64(3), int64(2), object(14)
memory usage: 64.1+ KB
```


Monitored Plans by Limit Unit
completion
Pass
audit
Occurrence
Event
Per Event
Monthly
Per event
Cycle
Trip
Period