# 911 Calls Data Capstone Project

January 18, 2018

## 1 911 Calls Capstone Project

For this capstone project we will be analyzing some 911 call data from Kaggle. The data contains the following fields:

- lat : String variable, Latitude
- lng: String variable, Longitude
- desc: String variable, Description of the Emergency Call
- zip: String variable, Zipcode
- title: String variable, Title
- timeStamp: String variable, YYYY-MM-DD HH:MM:SS
- twp: String variable, Township
- addr: String variable, Address
- e: String variable, Dummy variable (always 1)

Just go along with this notebook and try to complete the instructions or answer the questions in bold using your Python and Data Science skills!

### 1.1 Data and Setup

---

** Import numpy and pandas **

```
In [24]: import numpy as np
         import pandas as pd
```

** Import visualization libraries and set %matplotlib inline. **

```
In [25]: import matplotlib.pyplot as plt
         import seaborn as sns
         sns.set_style('whitegrid')
         %matplotlib inline
```

** Read in the csv file as a dataframe called df **

```
In [26]: df = pd.read_csv('911.csv')
```

** Check the info() of the df **

```
In [27]: df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 99492 entries, 0 to 99491
Data columns (total 9 columns):
lat          99492 non-null float64
lng          99492 non-null float64
desc         99492 non-null object
zip          86637 non-null float64
title        99492 non-null object
timeStamp    99492 non-null object
twp          99449 non-null object
addr         98973 non-null object
e            99492 non-null int64
dtypes: float64(3), int64(1), object(5)
memory usage: 6.8+ MB
```

** Check the head of df **

```
In [28]: df.head(3)

Out[28]:          lat        lng                                              desc  \
         0  40.297876 -75.581294  REINDEER CT & DEAD END;  NEW HANOVER; Station ...
         1  40.258061 -75.264680  BRIAR PATH & WHITEMARSH LN;  HATFIELD TOWNSHIP...
         2  40.121182 -75.351975  HAWS AVE; NORRISTOWN; 2015-12-10 @ 14:39:21-St...

                zip                    title            timeStamp                twp  \
         0  19525.0   EMS: BACK PAINS/INJURY  2015-12-10 17:40:00        NEW HANOVER
         1  19446.0  EMS: DIABETIC EMERGENCY  2015-12-10 17:40:00  HATFIELD TOWNSHIP
         2  19401.0      Fire: GAS-ODOR/LEAK  2015-12-10 17:40:00         NORRISTOWN

                                  addr  e
         0      REINDEER CT & DEAD END  1
         1  BRIAR PATH & WHITEMARSH LN  1
         2                    HAWS AVE  1
```

## 1.2 Basic Questions

** What are the top 5 zipcodes for 911 calls? **

```
In [29]: df['zip'].value_counts().head(5)

Out[29]: 19401.0    6979
         19464.0    6643
         19403.0    4854
         19446.0    4748
         19406.0    3174
         Name: zip, dtype: int64
```

** What are the top 5 townships (twp) for 911 calls? **

```
In [30]: df['twp'].value_counts().head(5)
```

```
Out[30]: LOWER MERION    8443
         ABINGTON        5977
         NORRISTOWN      5890
         UPPER MERION    5227
         CHELTENHAM      4575
         Name: twp, dtype: int64
```

** Take a look at the 'title' column, how many unique title codes are there? **

```
In [31]: df['title'].nunique()
```

```
Out[31]: 110
```

### 1.3 Creating new features

** In the titles column there are "Reasons/Departments" specified before the title code. These are EMS, Fire, and Traffic. Use .apply() with a custom lambda expression to create a new column called "Reason" that contains this string value.**

**For example, if the title column value is EMS: BACK PAINS/INJURY , the Reason column value would be EMS.**

```
In [32]: df['Reason'] = df['title'].apply(lambda title: title.split(':')[0])
```

** What is the most common Reason for a 911 call based off of this new column? **

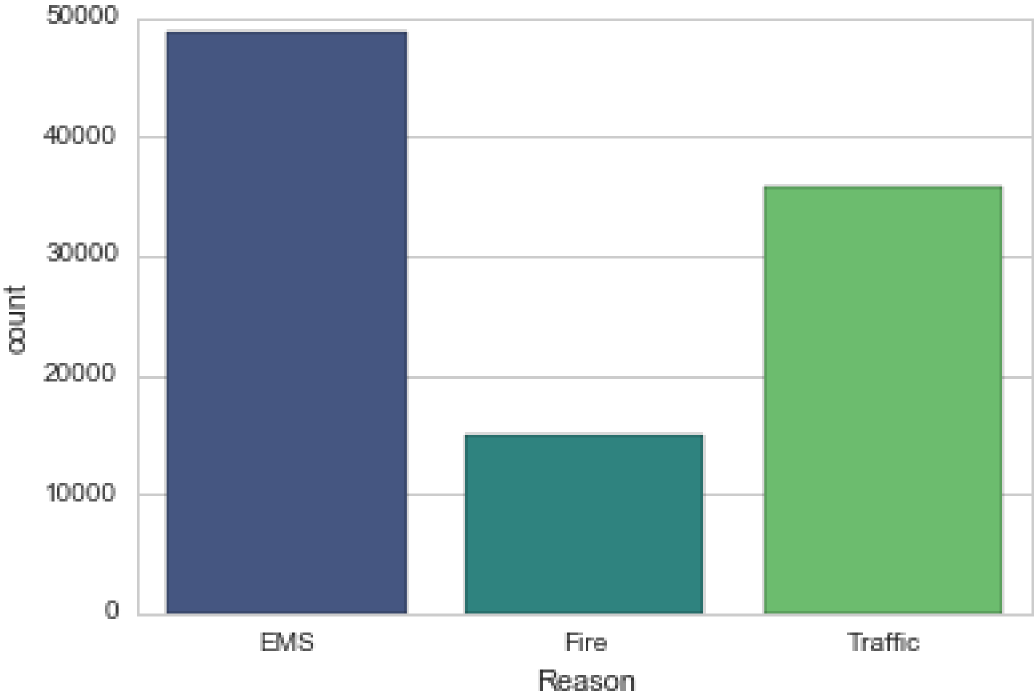
```
In [33]: df['Reason'].value_counts()
```

```
Out[33]: EMS        48877
         Traffic    35695
         Fire       14920
         Name: Reason, dtype: int64
```

** Now use seaborn to create a countplot of 911 calls by Reason. **

```
In [34]: sns.countplot(x='Reason',data=df,palette='viridis')
```

```
Out[34]: <matplotlib.axes._subplots.AxesSubplot at 0x121757b70>
```



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** Now let us begin to focus on time information. What is the data type of the objects in the timeStamp column? **

```
In [35]: type(df['timeStamp'].iloc[0])
```

```
Out[35]: str
```

** You should have seen that these timestamps are still strings. Use pd.to_datetime to convert the column from strings to DateTime objects. **

```
In [36]: df['timeStamp'] = pd.to_datetime(df['timeStamp'])
```

** You can now grab specific attributes from a Datetime object by calling them. For example:**

```
time = df['timeStamp'].iloc[0]
time.hour
```

**You can use Jupyter's tab method to explore the various attributes you can call. Now that the timestamp column are actually DateTime objects, use .apply() to create 3 new columns called Hour, Month, and Day of Week. You will create these columns based off of the timeStamp column, reference the solutions if you get stuck on this step.**

```
In [37]: df['Hour'] = df['timeStamp'].apply(lambda time: time.hour)
         df['Month'] = df['timeStamp'].apply(lambda time: time.month)
         df['Day of Week'] = df['timeStamp'].apply(lambda time: time.dayofweek)
```

** Notice how the Day of Week is an integer 0-6. Use the .map() with this dictionary to map the actual string names to the day of the week: **

```
dmap = {0:'Mon',1:'Tue',2:'Wed',3:'Thu',4:'Fri',5:'Sat',6:'Sun'}
```

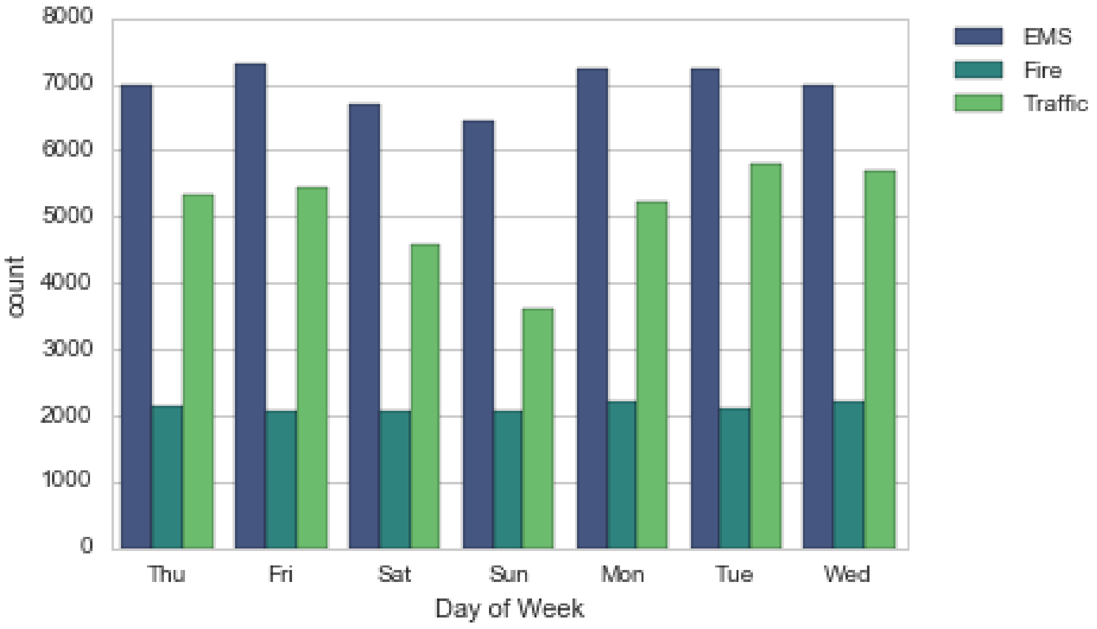
```
In [38]: dmap = {0:'Mon',1:'Tue',2:'Wed',3:'Thu',4:'Fri',5:'Sat',6:'Sun'}
```

```
In [39]: df['Day of Week'] = df['Day of Week'].map(dmap)
```

** Now use seaborn to create a countplot of the Day of Week column with the hue based off of the Reason column. **

```
In [40]: sns.countplot(x='Day of Week',data=df,hue='Reason',palette='viridis')

         # To relocate the legend
         plt.legend(bbox_to_anchor=(1.05, 1), loc=2, borderaxespad=0.)
```

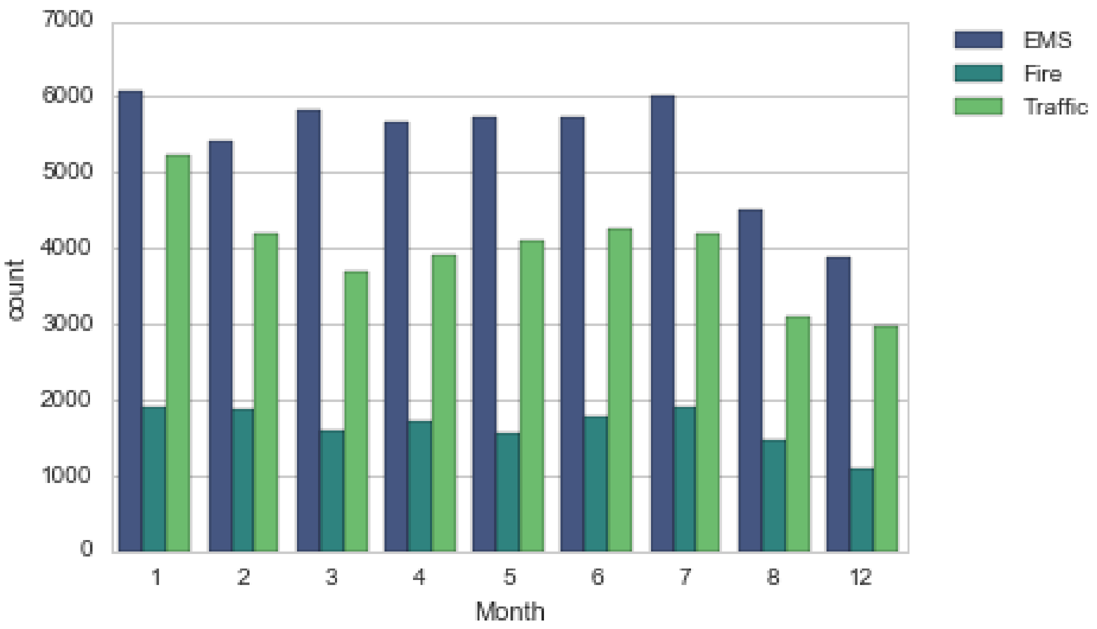
```
Out[40]: <matplotlib.legend.Legend at 0x121762710>
```



** Now do the same for Month:**

```
In [41]: sns.countplot(x='Month',data=df,hue='Reason',palette='viridis')

         # To relocate the legend
         plt.legend(bbox_to_anchor=(1.05, 1), loc=2, borderaxespad=0.)
```

```
Out[41]: <matplotlib.legend.Legend at 0x11fa7ad68>
```



** Did you notice something strange about the Plot? **

```
In [42]: # It is missing some months! 9,10, and 11 are not there.
```

** You should have noticed it was missing some Months, let's see if we can maybe fill in this information by plotting the information in another way, possibly a simple line plot that fills in the missing months, in order to do this, we'll need to do some work with pandas...**

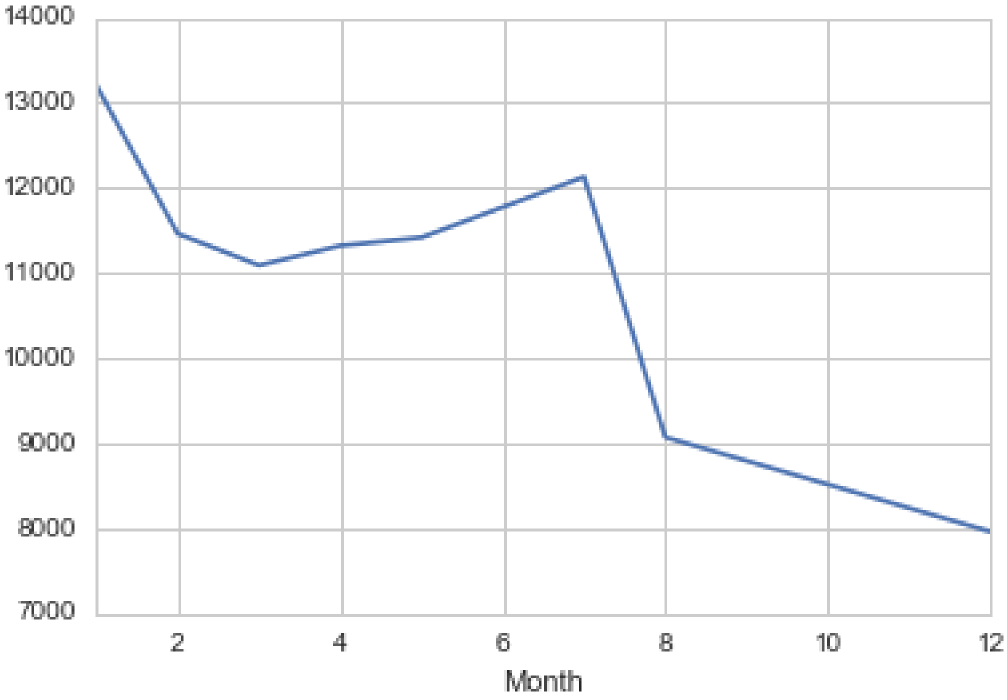
** Now create a gropuby object called byMonth, where you group the DataFrame by the month column and use the count() method for aggregation. Use the head() method on this returned DataFrame. **

```
In [43]: byMonth = df.groupby('Month').count()
         byMonth.head()
```

```
Out[43]:          lat    lng   desc    zip  title  timeStamp    twp   addr      e  \
         Month
         1      13205  13205  13205  11527  13205      13205  13203  13096  13205
         2      11467  11467  11467   9930  11467      11467  11465  11396  11467
         3      11101  11101  11101   9755  11101      11101  11092  11059  11101
         4      11326  11326  11326   9895  11326      11326  11323  11283  11326
         5      11423  11423  11423   9946  11423      11423  11420  11378  11423

                Reason   Hour  Day of Week
         Month
         1       13205  13205        13205
         2       11467  11467        11467
         3       11101  11101        11101
         4       11326  11326        11326
         5       11423  11423        11423
```

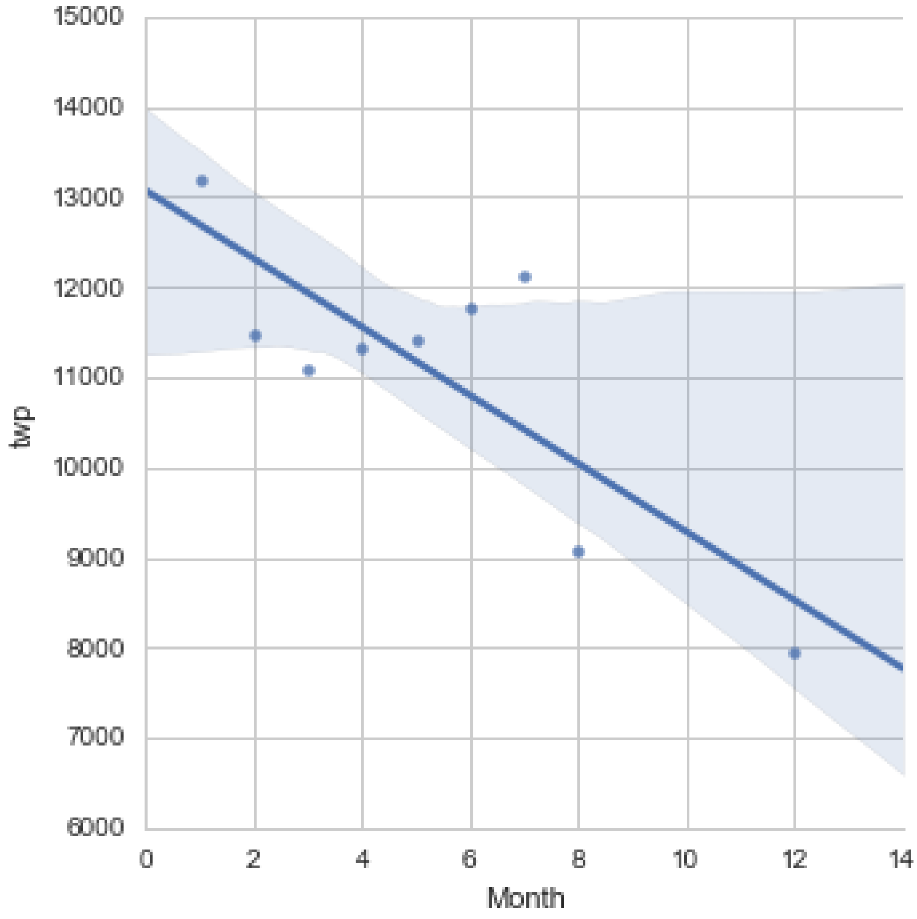
** Now create a simple plot off of the dataframe indicating the count of calls per month. **

```
In [44]: # Could be any column
         byMonth['twp'].plot()

Out[44]: <matplotlib.axes._subplots.AxesSubplot at 0x11fa06630>
```



** Now see if you can use seaborn's lmplot() to create a linear fit on the number of calls per month. Keep in mind you may need to reset the index to a column. **

```
In [45]: sns.lmplot(x='Month',y='twp',data=byMonth.reset_index())

Out[45]: <seaborn.axisgrid.FacetGrid at 0x11bf002b0>
```

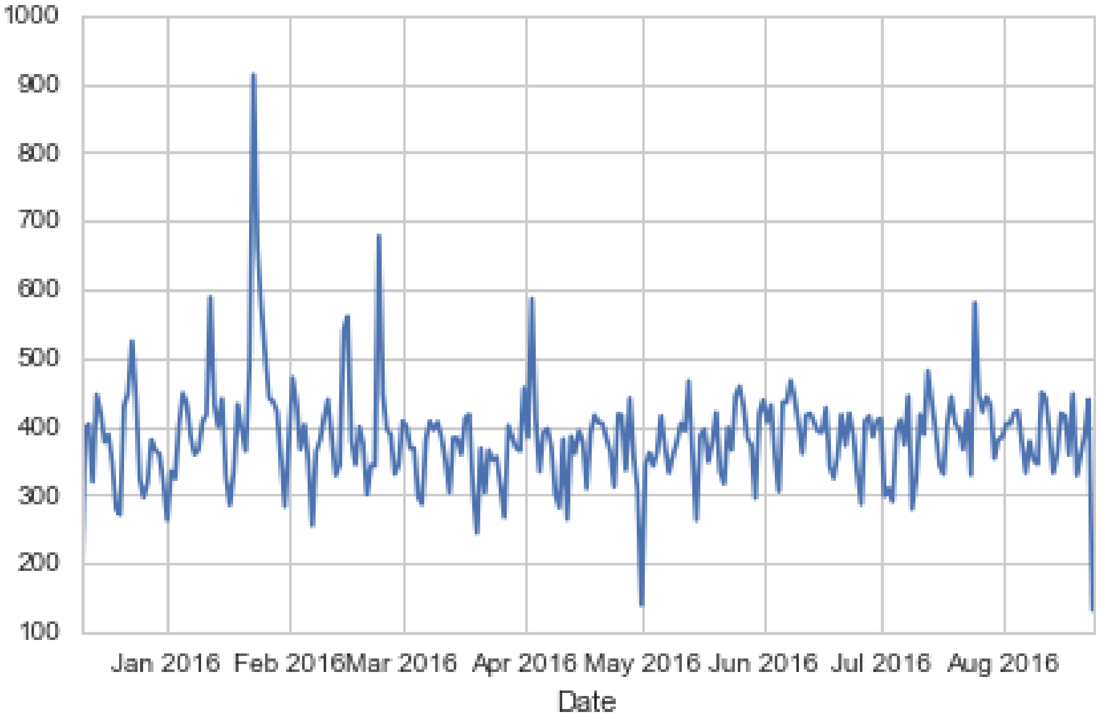


**Create a new column called 'Date' that contains the date from the timeStamp column. You'll need to use apply along with the .date() method.**

```
In [46]: df['Date']=df['timeStamp'].apply(lambda t: t.date())
```

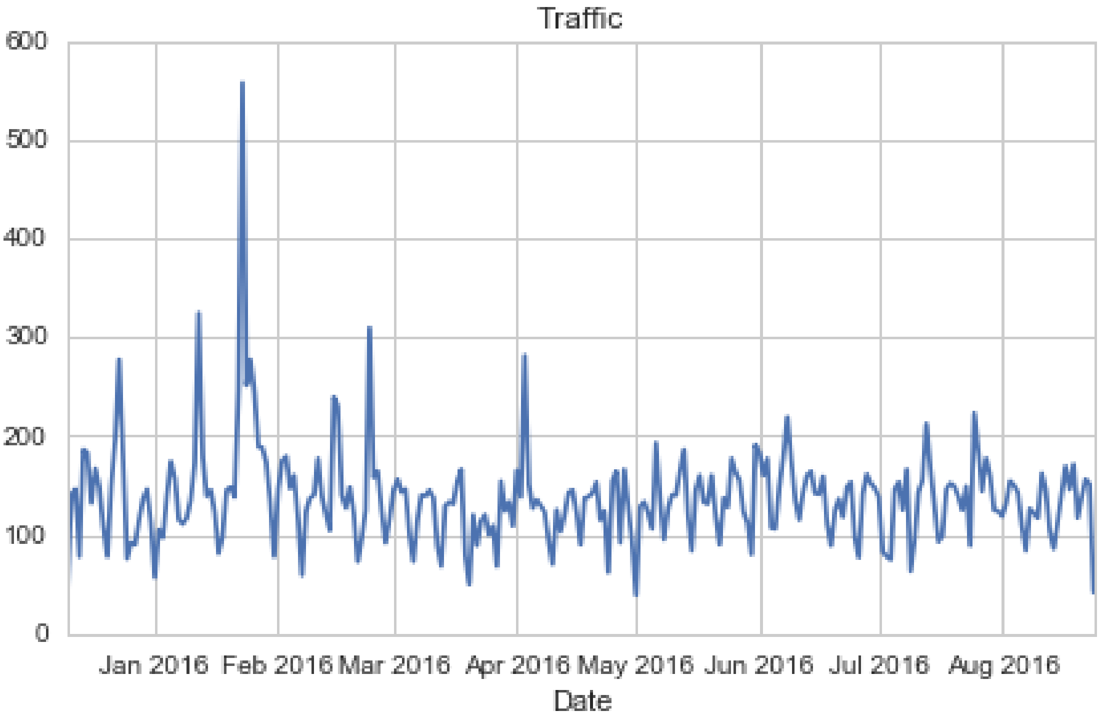
** Now groupby this Date column with the count() aggregate and create a plot of counts of 911 calls.**

```
In [47]: df.groupby('Date').count()['twp'].plot()
         plt.tight_layout()
```

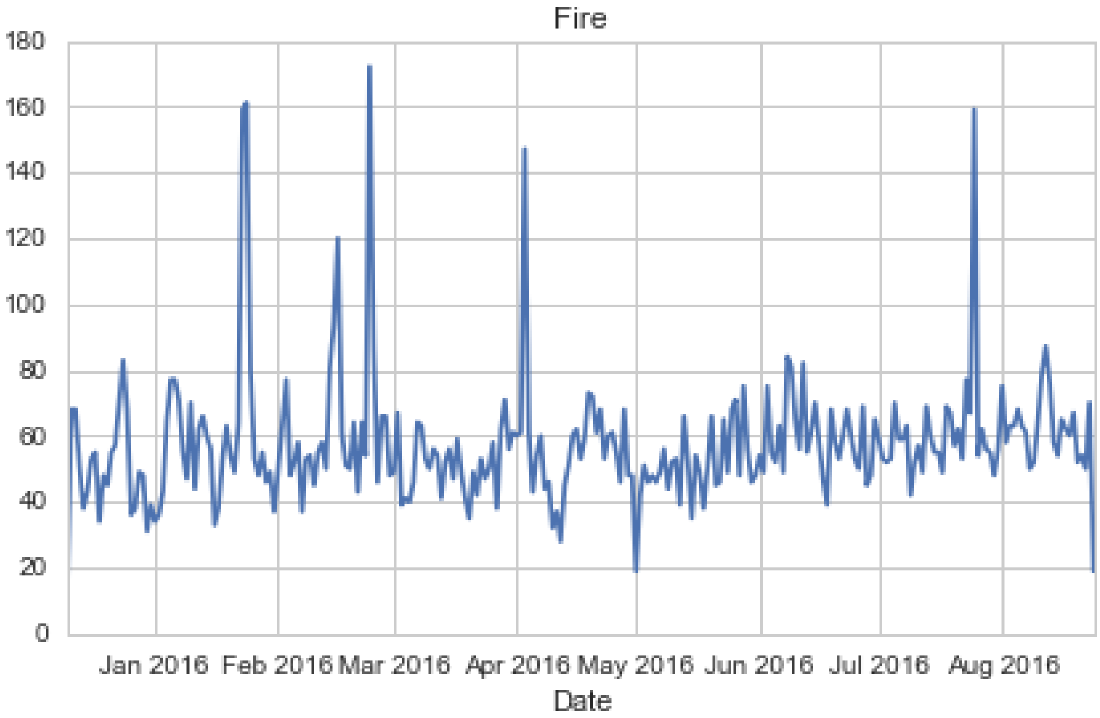


** Now recreate this plot but create 3 separate plots with each plot representing a Reason for the 911 call**

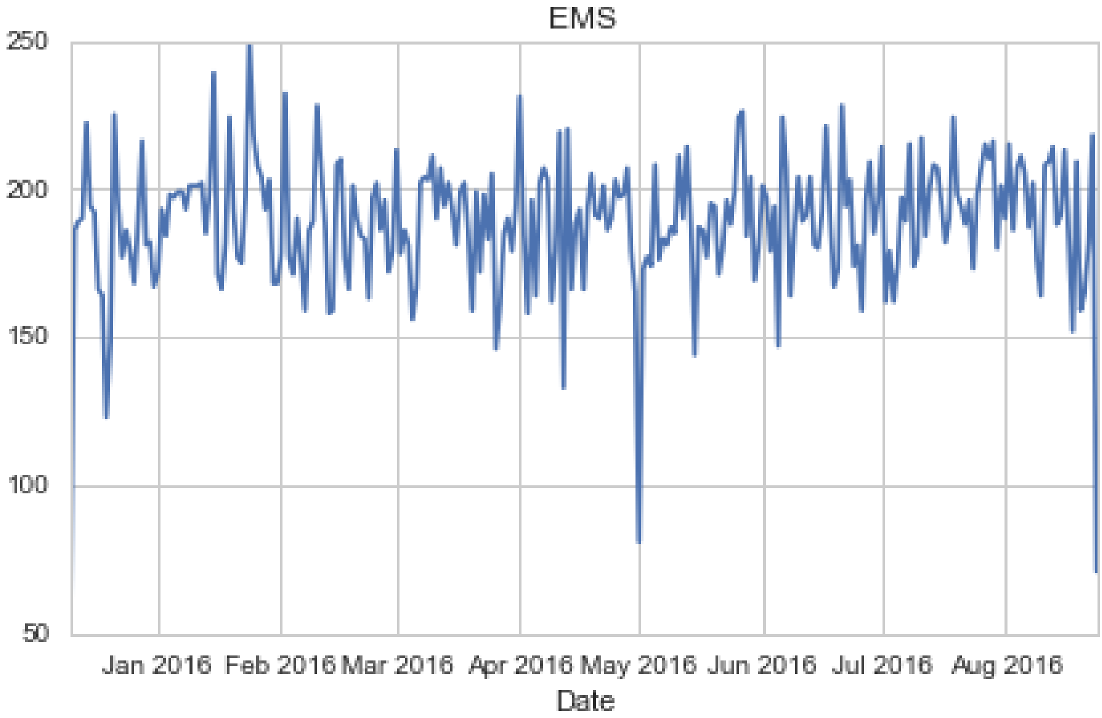
```
In [48]: df[df['Reason']=='Traffic'].groupby('Date').count()['twp'].plot()
         plt.title('Traffic')
         plt.tight_layout()
```



```
In [49]: df[df['Reason']=='Fire'].groupby('Date').count()['twp'].plot()
         plt.title('Fire')
         plt.tight_layout()
```



```
In [50]: df[df['Reason']=='EMS'].groupby('Date').count()['twp'].plot()
         plt.title('EMS')
         plt.tight_layout()
```



---

** Now let's move on to creating heatmaps with seaborn and our data. We'll first need to restructure the dataframe so that the columns become the Hours and the Index becomes the Day of the Week. There are lots of ways to do this, but I would recommend trying to combine groupby with an unstack method. Reference the solutions if you get stuck on this!**

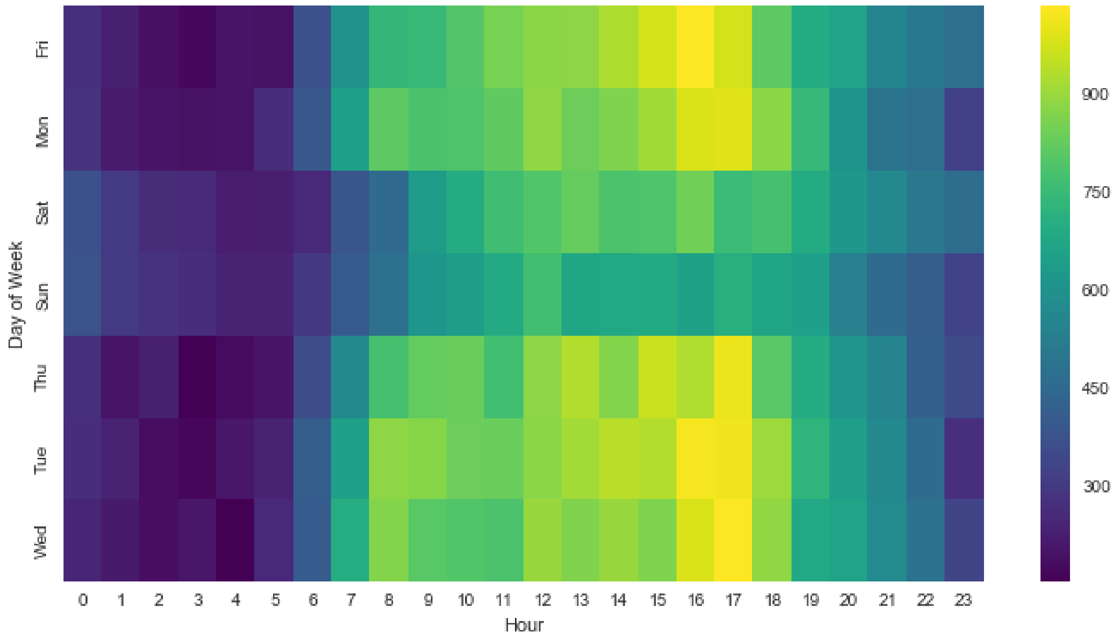
```
In [51]: dayHour = df.groupby(by=['Day of Week','Hour']).count()['Reason'].unstack()
         dayHour.head()
```

```
Out[51]: Hour           0    1    2    3    4    5    6    7    8    9  ...    14   15  \
         Day of Week                                                    ...
         Fri          275  235  191  175  201  194  372  598  742  752  ...   932  980
         Mon          282  221  201  194  204  267  397  653  819  786  ...   869  913
         Sat          375  301  263  260  224  231  257  391  459  640  ...   789  796
         Sun          383  306  286  268  242  240  300  402  483  620  ...   684  691
         Thu          278  202  233  159  182  203  362  570  777  828  ...   876  969

         Hour            16    17   18   19   20   21   22   23
         Day of Week
         Fri           1039   980  820  696  667  559  514  474
         Mon            989   997  885  746  613  497  472  325
         Sat            848   757  778  696  628  572  506  467
         Sun            663   714  670  655  537  461  415  330
```

```
Thu            935   1013   810   698   617   553   424   354

[5 rows x 24 columns]
```

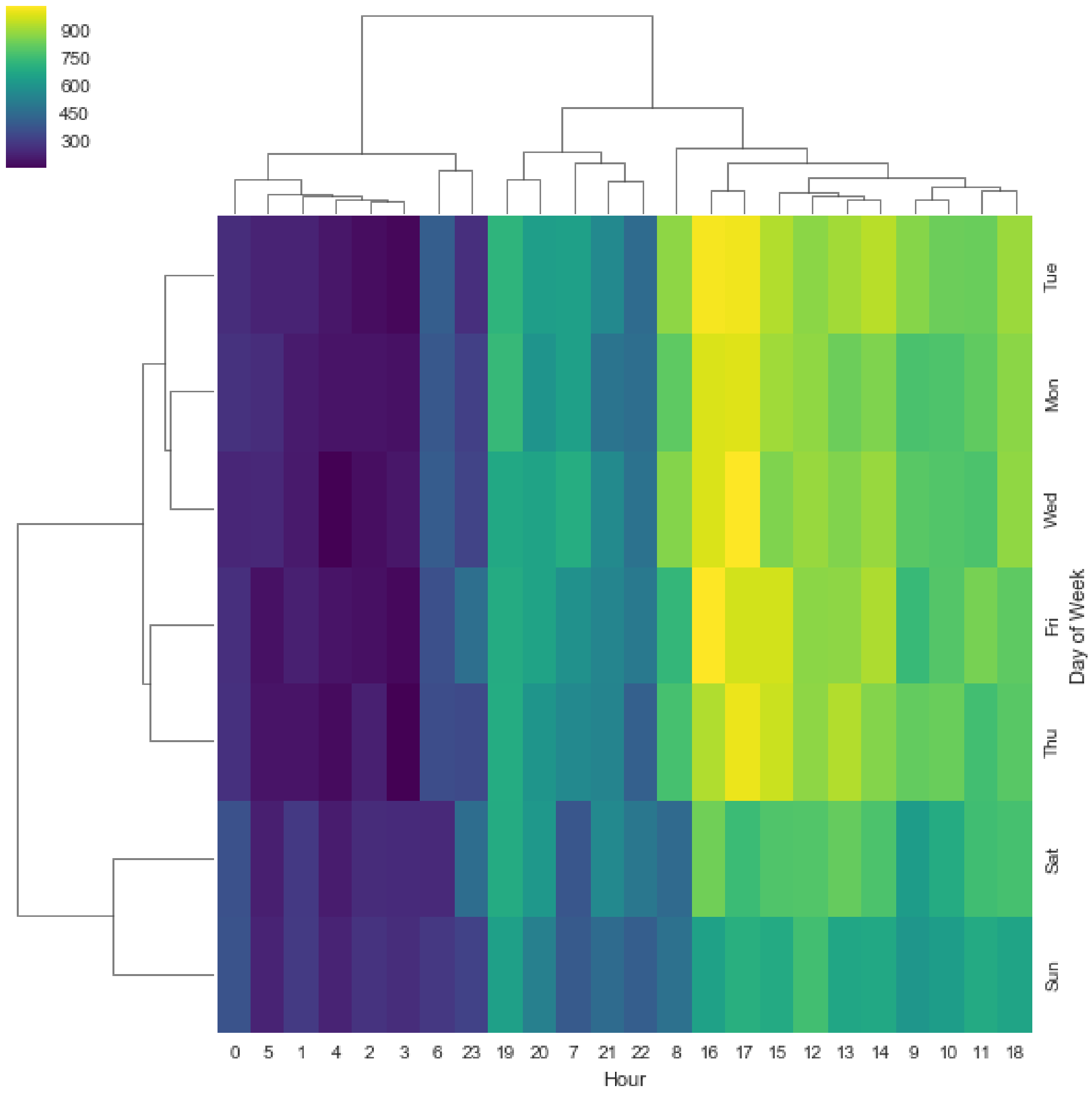
** Now create a HeatMap using this new DataFrame. **

```
In [52]: plt.figure(figsize=(12,6))
         sns.heatmap(dayHour,cmap='viridis')

Out[52]: <matplotlib.axes._subplots.AxesSubplot at 0x12305acf8>
```



** Now create a clustermap using this DataFrame. **

```
In [53]: sns.clustermap(dayHour,cmap='viridis')

Out[53]: <seaborn.matrix.ClusterGrid at 0x103276748>
```

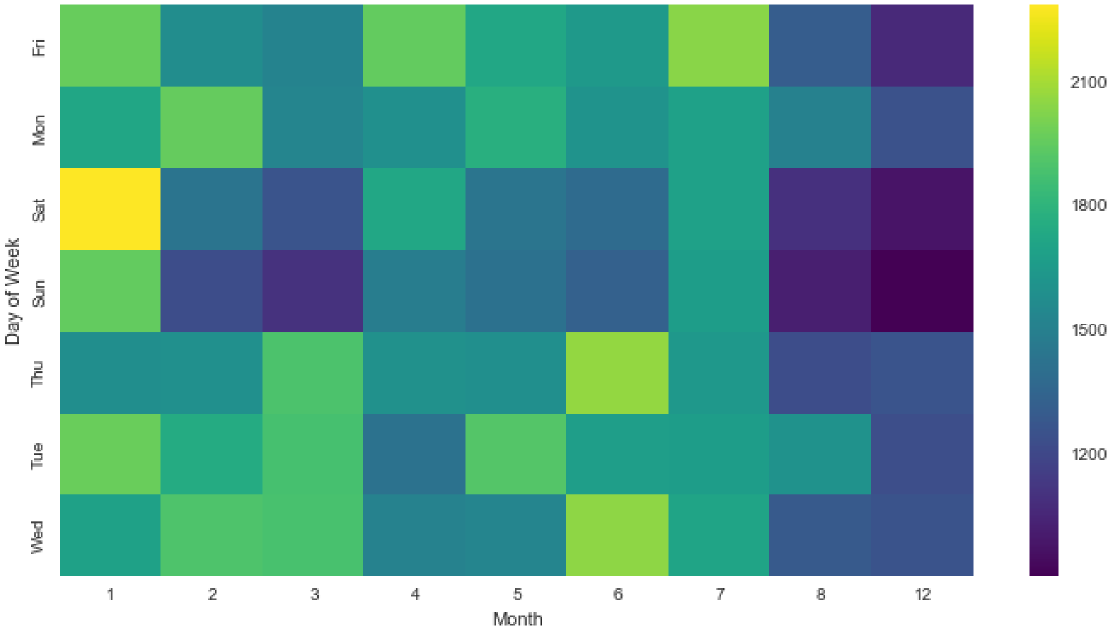


** Now repeat these same plots and operations, for a DataFrame that shows the Month as the column. **

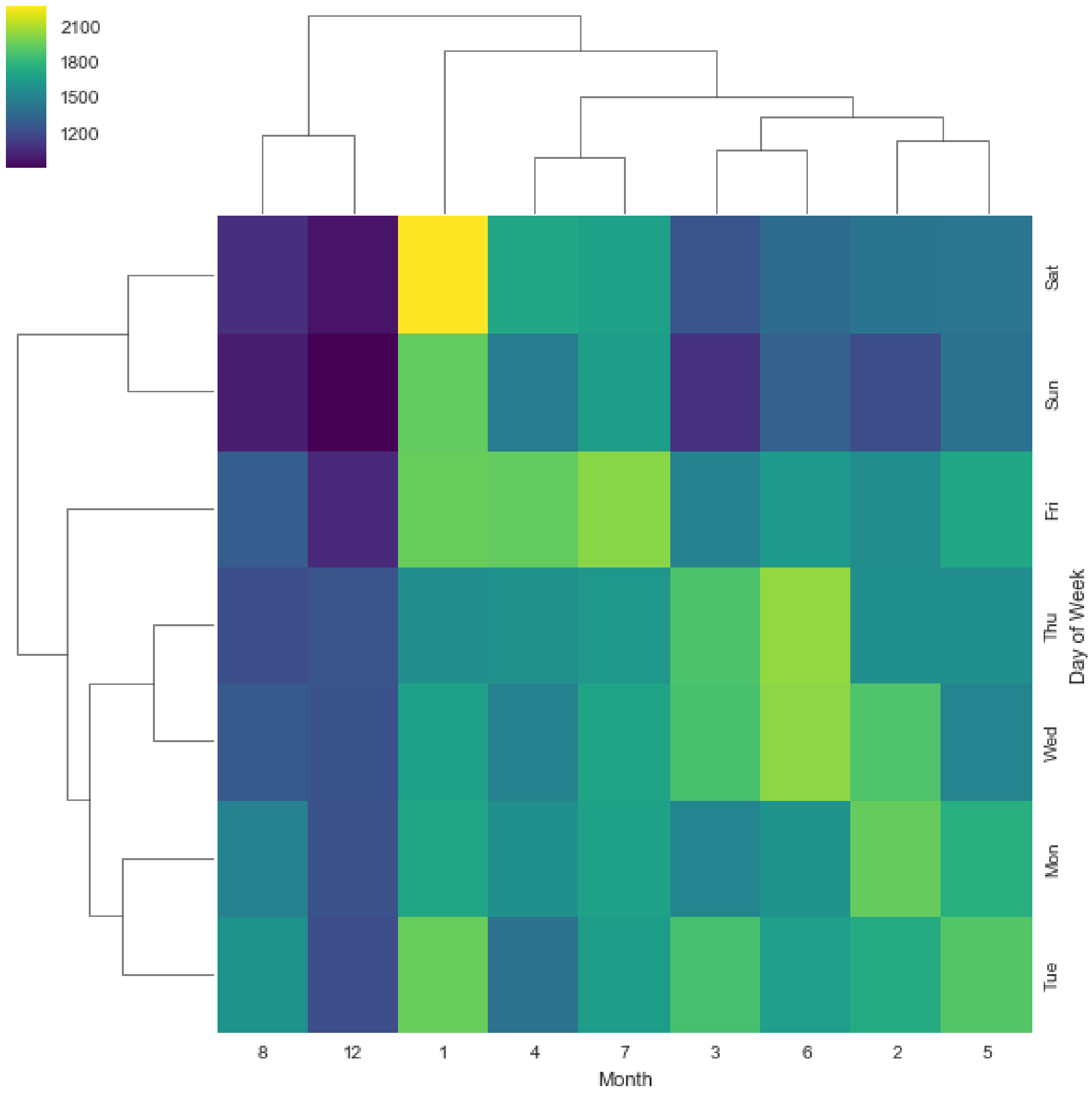
```
In [54]: dayMonth = df.groupby(by=['Day of Week','Month']).count()['Reason'].unstack()
         dayMonth.head()
```

```
Out[54]: Month           1     2     3     4     5     6     7     8     12
         Day of Week
         Fri          1970  1581  1525  1958  1730  1649  2045  1310  1065
         Mon          1727  1964  1535  1598  1779  1617  1692  1511  1257
         Sat          2291  1441  1266  1734  1444  1388  1695  1099   978
         Sun          1960  1229  1102  1488  1424  1333  1672  1021   907
         Thu          1584  1596  1900  1601  1590  2065  1646  1230  1266
```

```
In [55]: plt.figure(figsize=(12,6))
         sns.heatmap(dayMonth,cmap='viridis')

Out[55]: <matplotlib.axes._subplots.AxesSubplot at 0x11bcabf98>
```



```
In [56]: sns.clustermap(dayMonth,cmap='viridis')

Out[56]: <seaborn.matrix.ClusterGrid at 0x120341e80>
```



**Continue exploring the Data however you see fit!** # Great Job!