

911 continued

September 7, 2017

```
In [10]: import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

```
In [12]: df=pd.read_csv('911.csv')
```

```
In [15]: x=df['title'].iloc[0]
```

```
In [16]: x.split(':')[0]
```

```
Out[16]: 'EMS'
```

```
In [13]: df['Reason'] = df['title'].apply(lambda title: title.split()[0])
```

```
In [14]: df['Reason']
```

```
Out[14]: 0      EMS:
1      EMS:
2      Fire:
3      EMS:
4      EMS:
5      EMS:
6      EMS:
7      EMS:
8      EMS:
9      Traffic:
10     Traffic:
11     Traffic:
12     Traffic:
13     Traffic:
14     Traffic:
15     Traffic:
16     EMS:
17     EMS:
18     EMS:
19     Traffic:
20     Traffic:
```

```

21      Traffic:
22      Fire:
23      Traffic:
24      Traffic:
25      EMS:
26      EMS:
27      Fire:
28      Traffic:
29      Traffic:
...
127202    EMS:
127203    Traffic:
127204    EMS:
127205    EMS:
127206    EMS:
127207    Fire:
127208    Traffic:
127209    EMS:
127210    EMS:
127211    Traffic:
127212    Traffic:
127213    Traffic:
127214    Fire:
127215    Traffic:
127216    EMS:
127217    EMS:
127218    Traffic:
127219    EMS:
127220    EMS:
127221    Traffic:
127222    Traffic:
127223    Fire:
127224    Traffic:
127225    Traffic:
127226    EMS:
127227    Traffic:
127228    Traffic:
127229    EMS:
127230    Traffic:
127231    Traffic:
Name: Reason, dtype: object

```

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

```
In [17]: df['Reason'].value_counts()
```

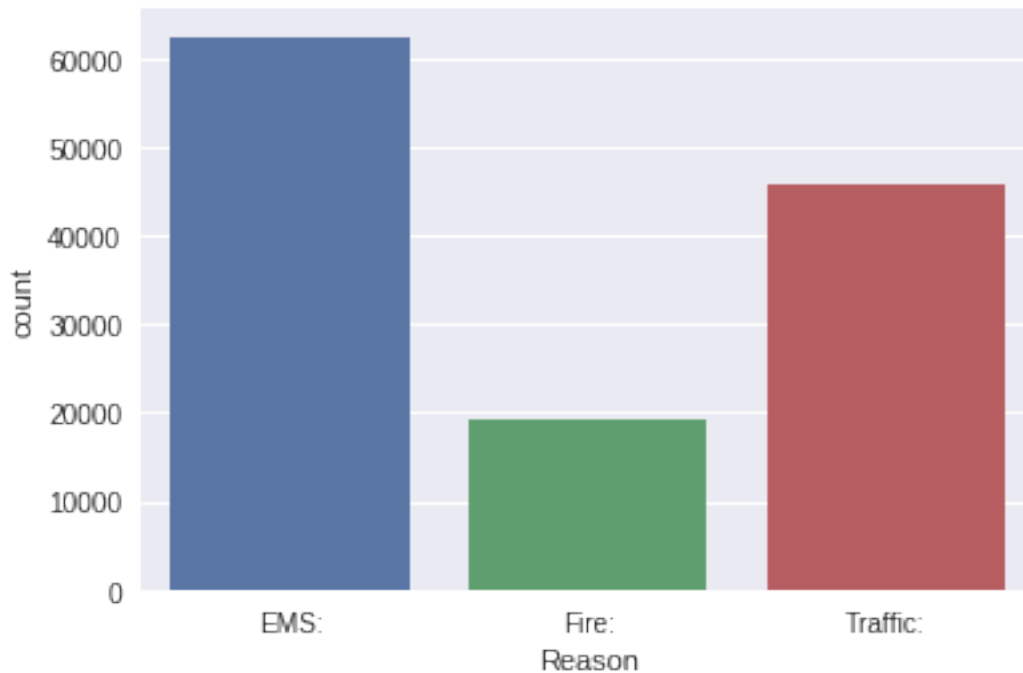
```
Out[17]: EMS:      62442
Traffic:  45631
```

```
Fire:      19159
Name: Reason, dtype: int64
```

Countplot of 911 calls by Reason using seaborn

```
In [19]: sns.countplot(x='Reason', data=df)
```

```
Out[19]: <matplotlib.axes._subplots.AxesSubplot at 0x7fbf9e671978>
```



What is the data type of the objects in the timeStamp column?

```
In [20]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 127232 entries, 0 to 127231
Data columns (total 10 columns):
lat      127232 non-null float64
lng      127232 non-null float64
desc     127232 non-null object
zip      110634 non-null float64
title    127232 non-null object
timeStamp 127232 non-null object
twp      127179 non-null object
addr     126598 non-null object
e        127232 non-null int64
Reason   127232 non-null object
```

```
dtypes: float64(3), int64(1), object(6)
memory usage: 9.7+ MB
```

Based on the above info() for df, the Data column labeled timeStamp is an object type.

```
In [24]: type(df['timeStamp'].iloc[0])
```

```
Out[24]: str
```

The timestamps are strings. Using pd.to_datetime will convert the column values from strings to DateTime objects.

```
In [25]: df['timeStamp'] = pd.to_datetime(df['timeStamp'])
```

```
In [26]: type(df['timeStamp'].iloc[0])
```

```
Out[26]: pandas.tslib.Timestamp
```

We can now grab specific attributes from a Datetime object by calling them for example:

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

We can use Jupyter's tab method to explore the various attributes we can call. Now that the timestamp column is actually DateTime objects, we use .apply() to create 3 new columns called Hour, Month, and Day of Week. These columns will be created based off of the timeStamp column.

```
In [40]: time=df['timeStamp'].iloc[0]
         time.hour
```

```
Out[40]: 17
```

```
In [39]: time
```

```
Out[39]: Timestamp('2015-12-10 17:10:52')
```

```
In [31]: time.year
```

```
Out[31]: 2015
```

```
In [32]: time.dayofweek
```

```
Out[32]: 3
```

```
In [34]: time.month
```

```
Out[34]: 12
```

Now we will call attributes off of the timeStamp column to create new Hour, Month, and Day of Week columns.

```
In [36]: df['Hour'] = df['timeStamp'].apply(lambda time: time.hour)
```

```
In [38]: df['Hour']
```

```
Out[38]: 0          17
         1          17
         2          14
         3          16
         4          16
         5          15
         6          16
         7          16
         8          16
         9          17
        10          17
        11          16
        12          17
        13          17
        14          17
        15          17
        16          17
        17          17
        18          17
        19          17
        20          17
        21          17
        22          17
        23          18
        24          17
        25          18
        26          18
        27          18
        28          18
        29          18
        ..
    127202          14
    127203          14
    127204          14
    127205          14
    127206          14
    127207          14
    127208          14
    127209          14
    127210          14
    127211          14
    127212          14
    127213          14
    127214          14
```

```

127215    14
127216    14
127217    14
127218    14
127219    14
127220    14
127221    14
127222    14
127223    15
127224    15
127225    15
127226    15
127227    15
127228    15
127229    15
127230    15
127231    15
Name: Hour, dtype: int64

```

```

In [43]: df['Month'] = df['timeStamp'].apply(lambda time: time.month)
         df['Day of Week'] = df['timeStamp'].apply(lambda time: time.dayofweek)

```

```

In [44]: df.head()

```

```

Out[44]:
```

	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...
3	40.116153	-75.343513	AIRY ST & SWEDE ST; NORRISTOWN; Station 308A;...
4	40.251492	-75.603350	CHERRYWOOD CT & DEAD END; LOWER POTTS GROVE; S...

	zip	title	timeStamp	twp
0	19525.0	EMS: BACK PAINS/INJURY	2015-12-10 17:10:52	NEW HANOVER
1	19446.0	EMS: DIABETIC EMERGENCY	2015-12-10 17:29:21	HATFIELD TOWNSHIP
2	19401.0	Fire: GAS-ODOR/LEAK	2015-12-10 14:39:21	NORRISTOWN
3	19401.0	EMS: CARDIAC EMERGENCY	2015-12-10 16:47:36	NORRISTOWN
4	NaN	EMS: DIZZINESS	2015-12-10 16:56:52	LOWER POTTS GROVE

	addr	e	Reason	Hour	Month	Day of Week
0	REINDEER CT & DEAD END	1	EMS:	17	12	3
1	BRIAR PATH & WHITEMARSH LN	1	EMS:	17	12	3
2	HAWS AVE	1	Fire:	14	12	3
3	AIRY ST & SWEDE ST	1	EMS:	16	12	3
4	CHERRYWOOD CT & DEAD END	1	EMS:	16	12	3

Notice how the Day of Week values are integers from 0-6. We will use `.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 [45]: dmap = {0:'Mon', 1:'Tue', 2:'Wed', 3:'Thu', 4:'Fri', 5:'Sat', 6:'Sun'}
```

```
In [46]: df['Day of Week'] = df['Day of Week'].map(dmap)
```

```
In [47]: df.head()
```

```
Out[47]:
```

	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...	
3	40.116153	-75.343513	AIRY ST & SWEDE ST; NORRISTOWN; Station 308A;...	
4	40.251492	-75.603350	CHERRYWOOD CT & DEAD END; LOWER POTTS GROVE; S...	

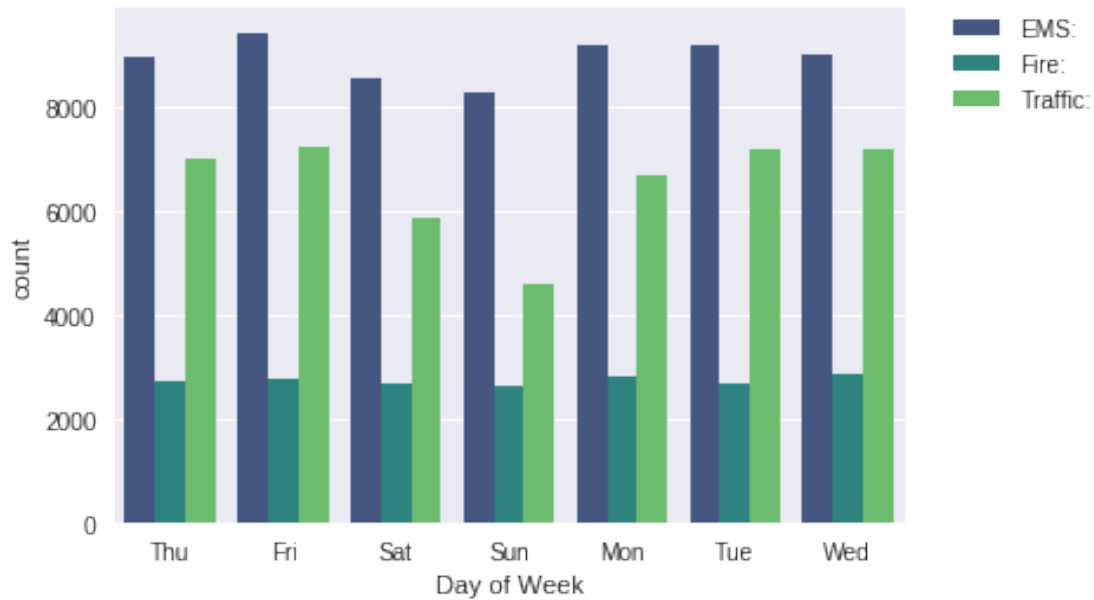
	zip	title	timeStamp	twp	\
0	19525.0	EMS: BACK PAINS/INJURY	2015-12-10 17:10:52	NEW HANOVER	
1	19446.0	EMS: DIABETIC EMERGENCY	2015-12-10 17:29:21	HATFIELD TOWNSHIP	
2	19401.0	Fire: GAS-ODOR/LEAK	2015-12-10 14:39:21	NORRISTOWN	
3	19401.0	EMS: CARDIAC EMERGENCY	2015-12-10 16:47:36	NORRISTOWN	
4	NaN	EMS: DIZZINESS	2015-12-10 16:56:52	LOWER POTTS GROVE	

	addr	e	Reason	Hour	Month	Day	of Week
0	REINDEER CT & DEAD END	1	EMS:	17	12		Thu
1	BRIAR PATH & WHITEMARSH LN	1	EMS:	17	12		Thu
2	HAWS AVE	1	Fire:	14	12		Thu
3	AIRY ST & SWEDE ST	1	EMS:	16	12		Thu
4	CHERRYWOOD CT & DEAD END	1	EMS:	16	12		Thu

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

```
In [54]: 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.)
```

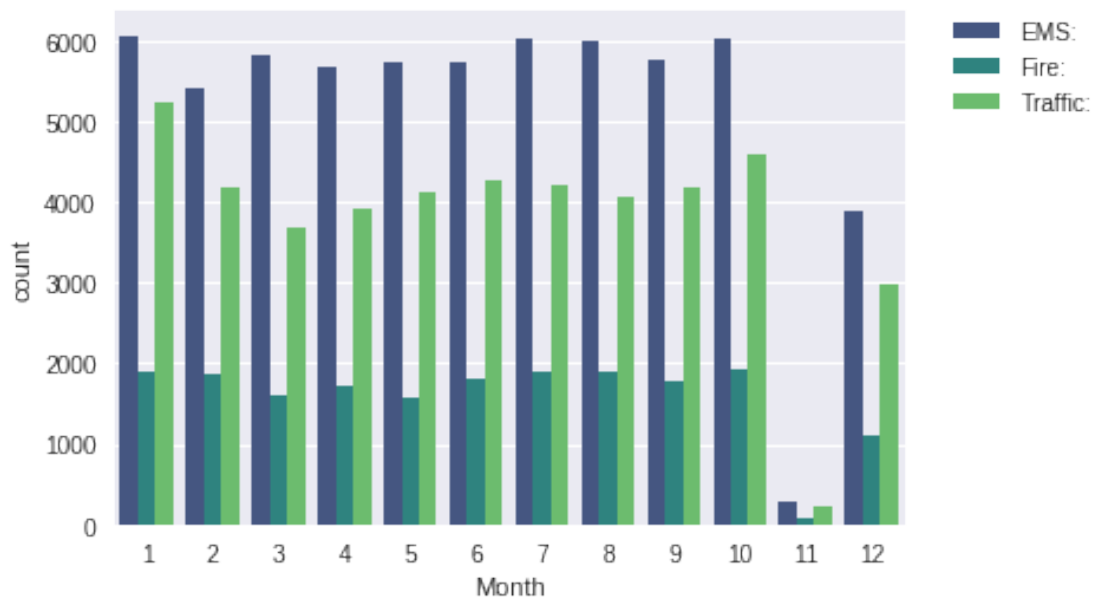
```
Out[54]: <matplotlib.legend.Legend at 0x7fbf9d906780>
```



Now we use seaborn to create a countplot of the Month column with the hue based off of the Reason column.

```
In [55]: 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[55]: <matplotlib.legend.Legend at 0x7fbf9d87dba8>
```



Create a groupby objected called byMonth, where the DataFrame is grouped by the month column and the count() method is used for agreegation.

```
In [59]: byMonth = df.groupby('Month').count()
```

```
In [65]: byMonth.head()
```

```
Out[65]:
```

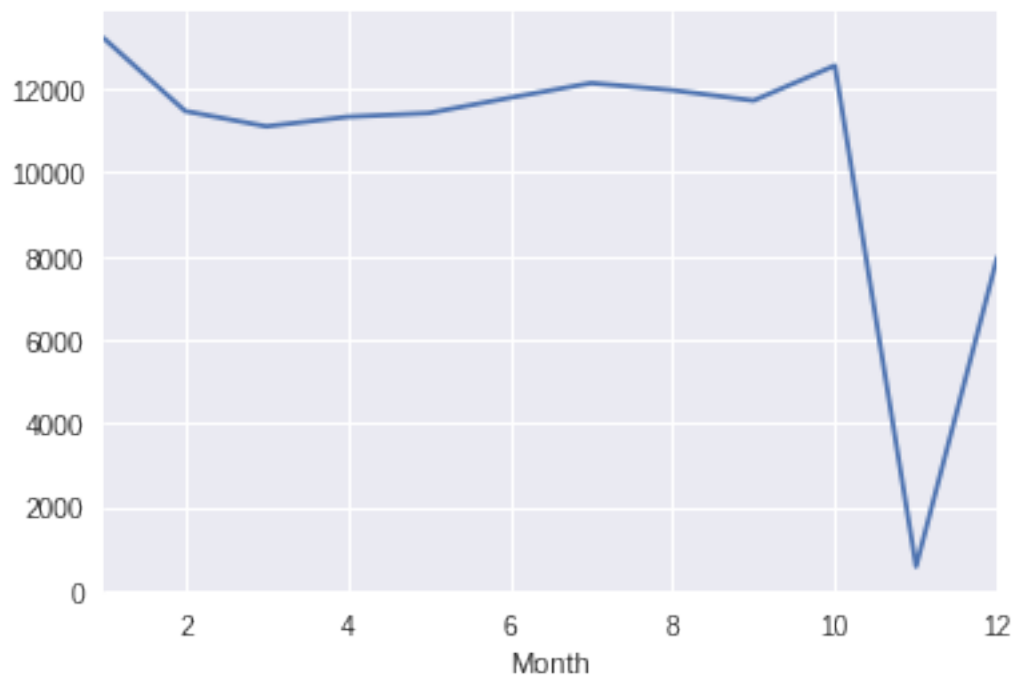
	lat	lng	desc	zip	title	timeStamp	twp	addr	e	\
Month										
1	13205	13205	13205	11527	13205	13205	13203	13096	13205	
2	11467	11467	11467	9930	11467	11467	11465	11396	11467	
3	11101	11101	11101	9755	11101	11101	11092	11059	11101	
4	11330	11330	11330	9899	11330	11330	11327	11287	11330	
5	11419	11419	11419	9942	11419	11419	11416	11374	11419	

	Reason	Hour	Day of Week
Month			
1	13205	13205	13205
2	11467	11467	11467
3	11101	11101	11101
4	11330	11330	11330
5	11419	11419	11419

Create a simple plot off of the dataframe indicating the count of calls per month.

```
In [62]: byMonth['lat'].plot()
```

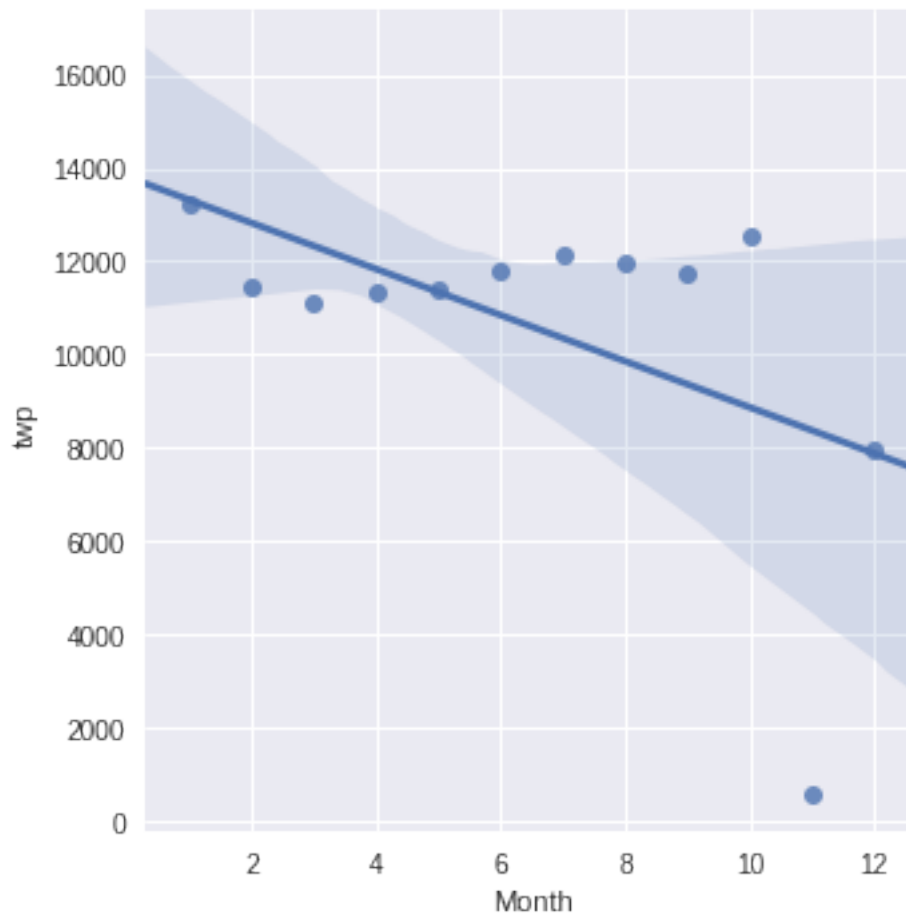
```
Out[62]: <matplotlib.axes._subplots.AxesSubplot at 0x7fbf9d633978>
```



Use seaborn's `lmplot()` to create a linear fit on the number of calls per month.

```
In [63]: sns.lmplot(x='Month', y='twp', data=byMonth.reset_index())
```

```
Out[63]: <seaborn.axisgrid.FacetGrid at 0x7fbf9d598978>
```



Create a new column called 'Date' that contains the date from the `timeStamp` column. Using `apply()` along with `date()` method.

```
In [69]: t = df['timeStamp'].iloc[0]
```

```
In [70]: t
```

```
Out[70]: Timestamp('2015-12-10 17:10:52')
```

```
In [72]: t.date()
```

```
Out[72]: datetime.date(2015, 12, 10)
```

```
In [74]: df['Date'] = df['timeStamp'].apply(lambda t: t.date())
```

```
In [76]: df.head()
```

```
Out[76]:
```

	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...	
3	40.116153	-75.343513	AIRY ST & SWEDE ST; NORRISTOWN; Station 308A;...	
4	40.251492	-75.603350	CHERRYWOOD CT & DEAD END; LOWER POTTS GROVE; S...	

	zip	title	timeStamp	twp	\
0	19525.0	EMS: BACK PAINS/INJURY	2015-12-10 17:10:52	NEW HANOVER	
1	19446.0	EMS: DIABETIC EMERGENCY	2015-12-10 17:29:21	HATFIELD TOWNSHIP	
2	19401.0	Fire: GAS-ODOR/LEAK	2015-12-10 14:39:21	NORRISTOWN	
3	19401.0	EMS: CARDIAC EMERGENCY	2015-12-10 16:47:36	NORRISTOWN	
4	NaN	EMS: DIZZINESS	2015-12-10 16:56:52	LOWER POTTS GROVE	

	addr	e	Reason	Hour	Month	Day	of Week	Date
0	REINDEER CT & DEAD END	1	EMS:	17	12	Thu	2015-12-10	
1	BRIAR PATH & WHITEMARSH LN	1	EMS:	17	12	Thu	2015-12-10	
2	HAWS AVE	1	Fire:	14	12	Thu	2015-12-10	
3	AIRY ST & SWEDE ST	1	EMS:	16	12	Thu	2015-12-10	
4	CHERRYWOOD CT & DEAD END	1	EMS:	16	12	Thu	2015-12-10	

```
In [79]: df.groupby('Date').count().head()
```

```
Out[79]:
```

	lat	lng	desc	zip	title	timeStamp	twp	addr	e	Reason	\
Date											
2015-12-10	116	116	116	101	116	116	116	114	116	116	
2015-12-11	396	396	396	333	396	396	395	391	396	396	
2015-12-12	404	404	404	334	404	404	404	402	404	404	
2015-12-13	318	318	318	279	318	318	318	316	318	318	
2015-12-14	446	446	446	386	446	446	445	444	446	446	

	Hour	Month	Day	of Week
Date				
2015-12-10	116	116		116
2015-12-11	396	396		396
2015-12-12	404	404		404
2015-12-13	318	318		318
2015-12-14	446	446		446

```
In [81]: df.groupby('Date').count()['lat']
```

```
Out[81]:
```

Date	lat
2015-12-10	116
2015-12-11	396
2015-12-12	404

2015-12-13	318
2015-12-14	446
2015-12-15	421
2015-12-16	377
2015-12-17	388
2015-12-18	346
2015-12-19	279
2015-12-20	272
2015-12-21	429
2015-12-22	448
2015-12-23	524
2015-12-24	448
2015-12-25	321
2015-12-26	295
2015-12-27	317
2015-12-28	380
2015-12-29	367
2015-12-30	359
2015-12-31	318
2016-01-01	263
2016-01-02	336
2016-01-03	323
2016-01-04	402
2016-01-05	448
2016-01-06	434
2016-01-07	385
2016-01-08	359
	...
2016-10-04	343
2016-10-05	446
2016-10-06	438
2016-10-07	478
2016-10-08	354
2016-10-09	373
2016-10-10	399
2016-10-11	420
2016-10-12	413
2016-10-13	399
2016-10-14	433
2016-10-15	387
2016-10-16	309
2016-10-17	452
2016-10-18	424
2016-10-19	457
2016-10-20	390
2016-10-21	498
2016-10-22	457
2016-10-23	327

```

2016-10-24    382
2016-10-25    360
2016-10-26    386
2016-10-27    405
2016-10-28    500
2016-10-29    402
2016-10-30    435
2016-10-31    452
2016-11-01    365
2016-11-02    212
Name: lat, dtype: int64

```

```

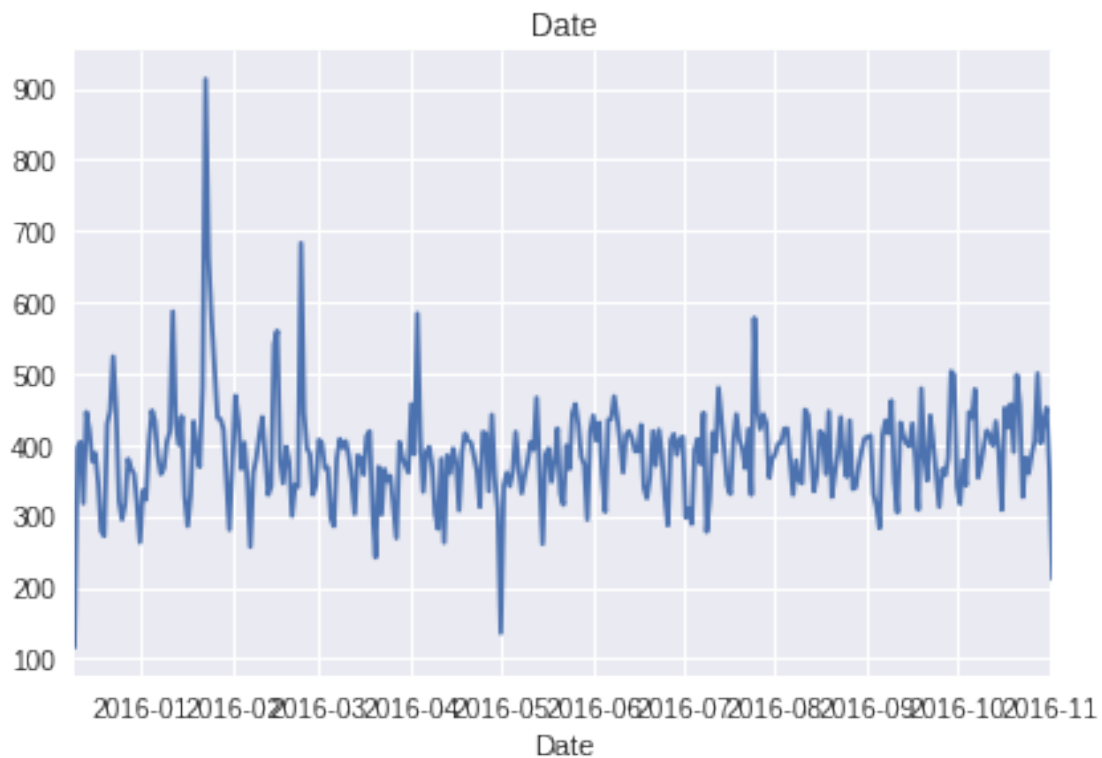
In [93]: df.groupby('Date').count()['lat'].plot()
plt.tight_layout()
plt.title('Date')

```

```

Out[93]: <matplotlib.text.Text at 0x7fbf9d16d978>

```



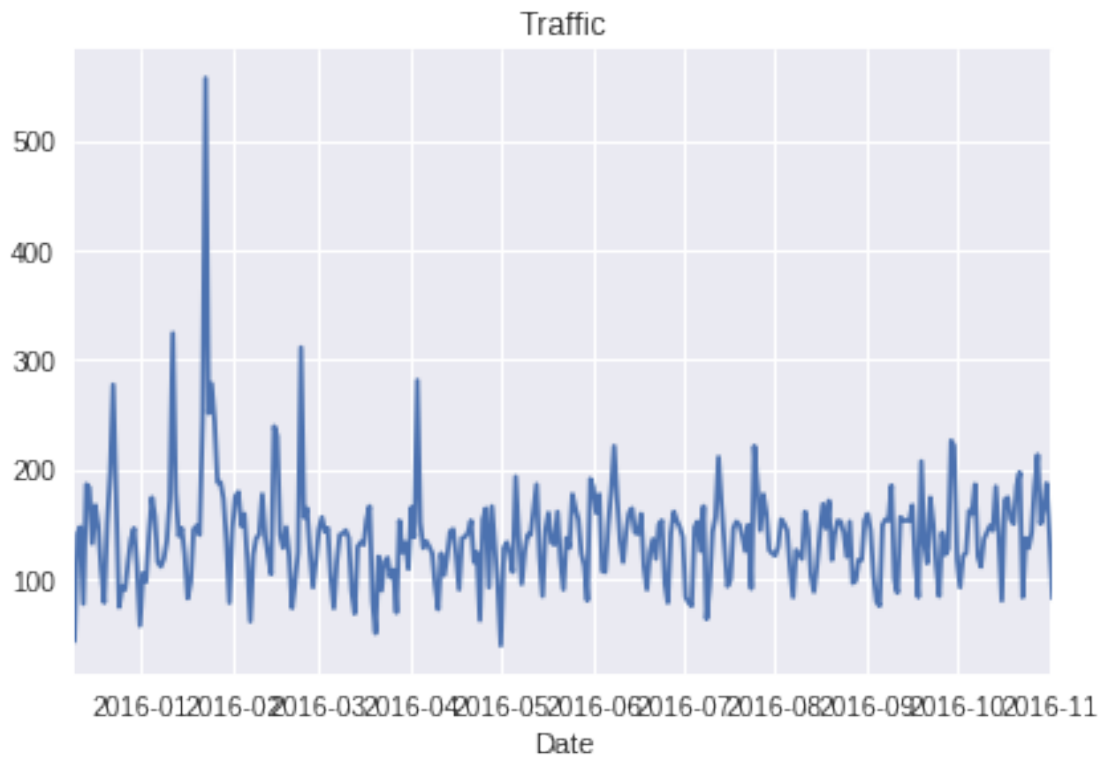
Re-create this plot but create 3 separate plots with each plot representing a Reason for the 911 call.

```

In [96]: df[df['Reason']=='Traffic:'].groupby('Date').count()['lat'].plot()
plt.tight_layout()
plt.title('Traffic')

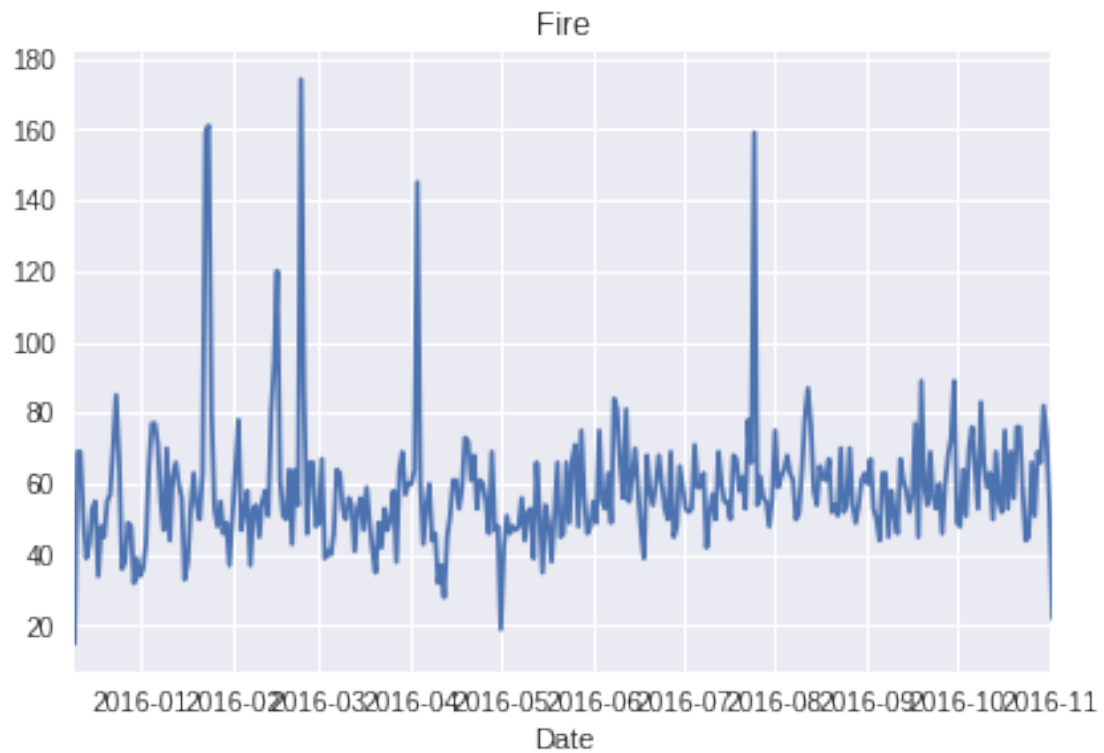
```

Out[96]: <matplotlib.text.Text at 0x7fbf9d28ab38>



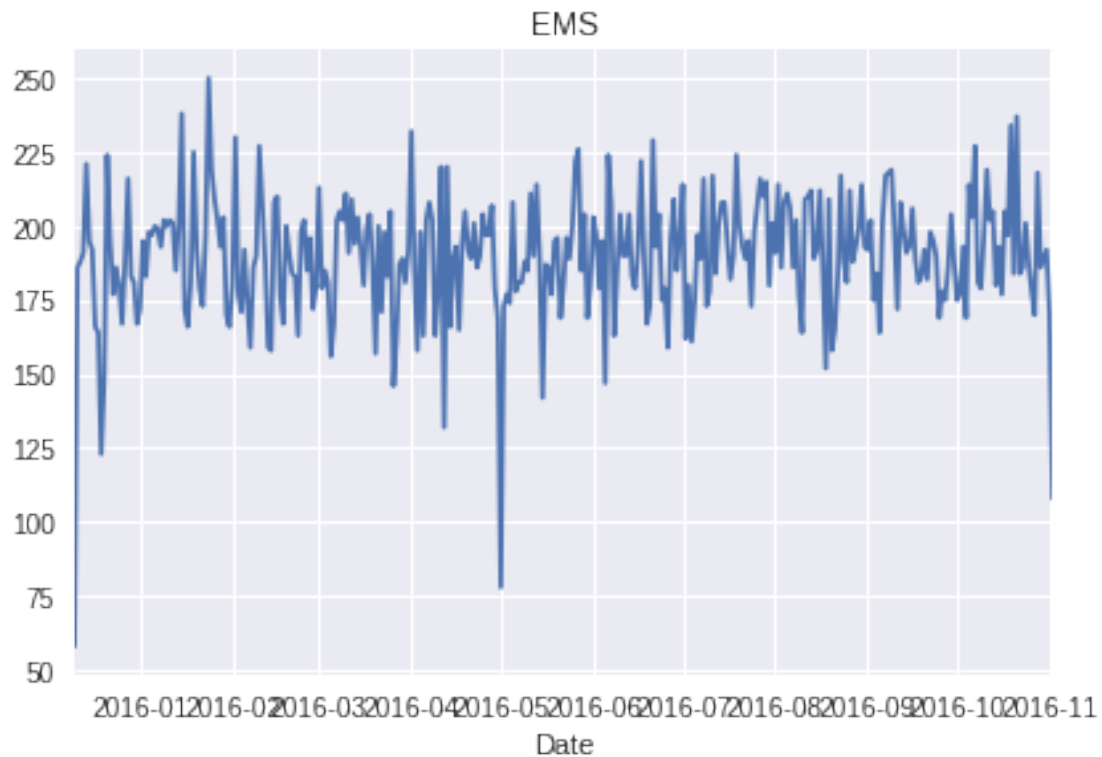
```
In [97]: df[df['Reason']=='Fire:'].groupby('Date').count()['lat'].plot()  
plt.tight_layout()  
plt.title('Fire')
```

Out[97]: <matplotlib.text.Text at 0x7fbf9d300940>



```
In [98]: df[df['Reason']=='EMS:'].groupby('Date').count()['lat'].plot()  
plt.tight_layout()  
plt.title('EMS')
```

```
Out[98]: <matplotlib.text.Text at 0x7fbf9d32a588>
```

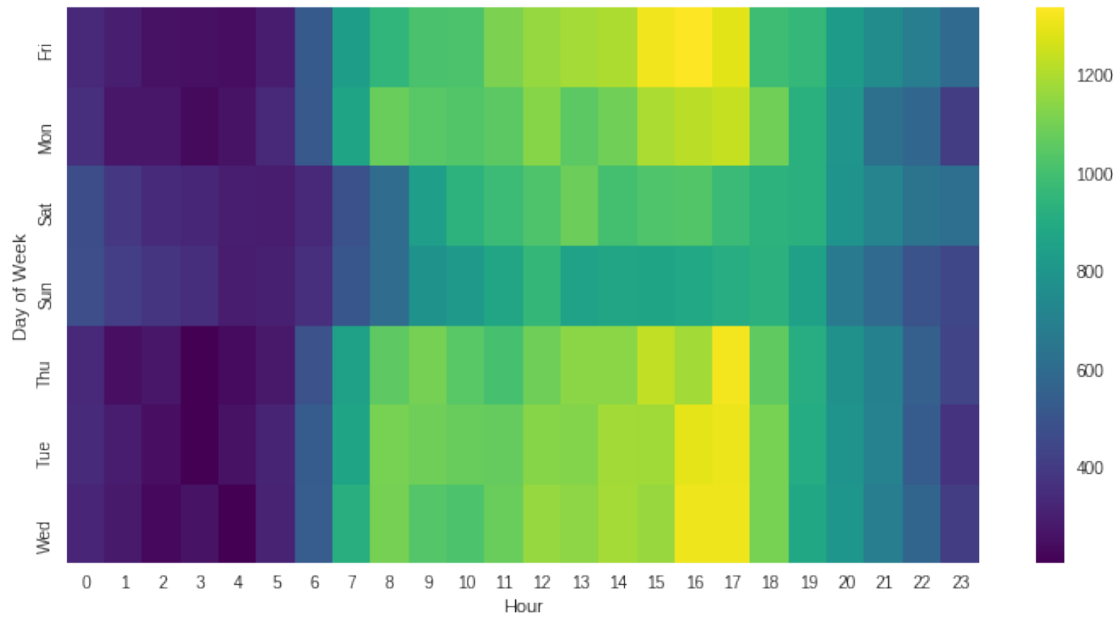


Create heatmaps with seaborn and our data. The dataframe will first be restructured so that the columns become the Hours and Index becomes the Day of the Week. The unstack method will be used, combined with groupby.

```
In [109]: dayHour=df.groupby(by=['Day of Week', 'Hour']).count()['Reason'].unstack()
```

```
In [114]: plt.figure(figsize=(12,6))
          sns.heatmap(dayHour, cmap='viridis')
```

```
Out[114]: <matplotlib.axes._subplots.AxesSubplot at 0x7fbf9cf7a6d8>
```

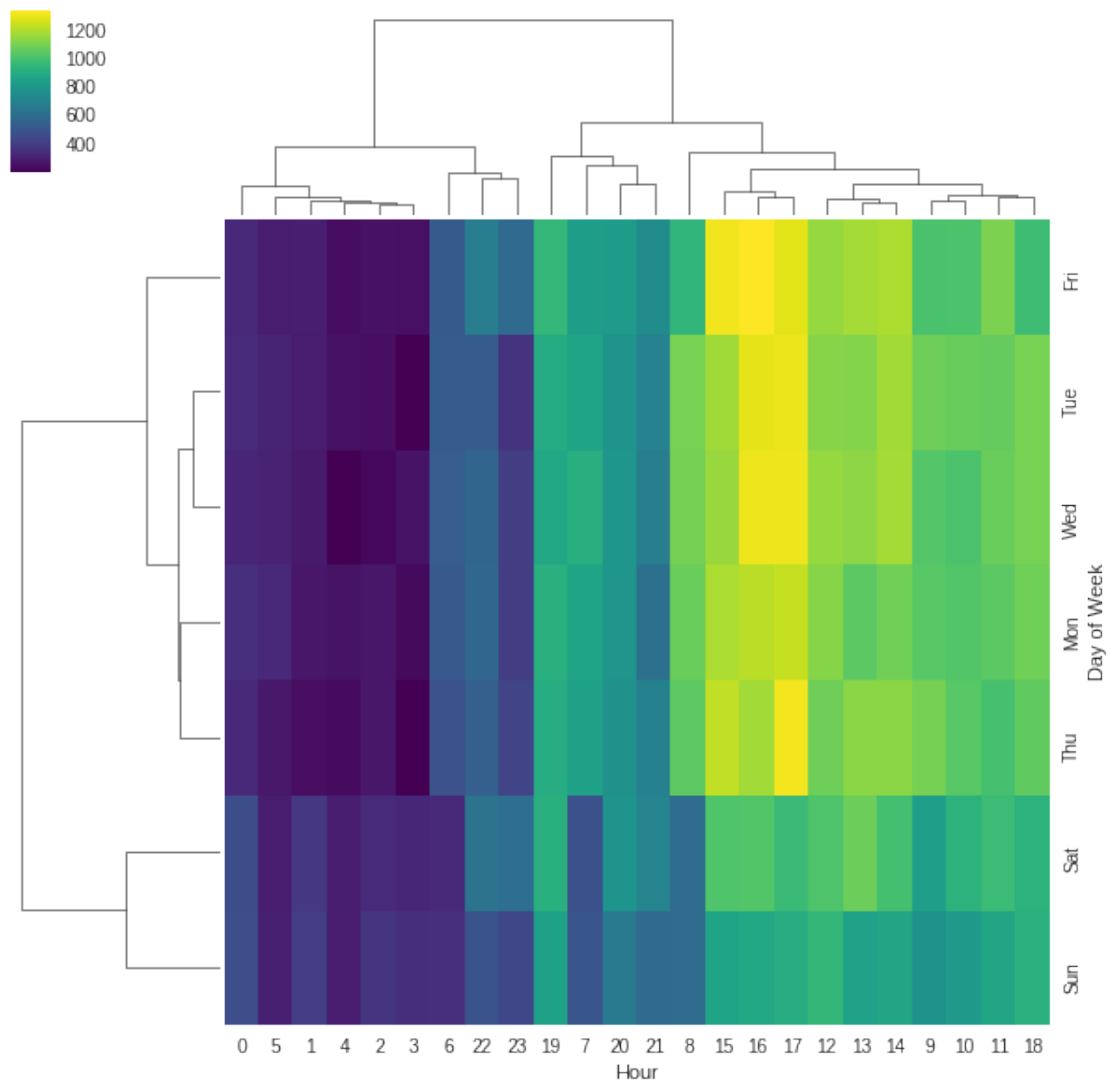



Create a clustermap using this dataframe

```
In [120]: sns.clustermap(dayHour, cmap='viridis')
```

```
/opt/conda/lib/python3.6/site-packages/matplotlib/cbook.py:136: MatplotlibDeprecationWarning: The
warnings.warn(message, mplDeprecation, stacklevel=1)
```

```
Out[120]: <seaborn.matrix.ClusterGrid at 0x7fbf9b4b9fd0>
```



In []: