911 Calls Capstone Project

For this capstone project we will be analyzing some 911 call data from Kaggle (https://www.kaggle.com/mchirico/montcoalert). 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!

Data and Setup

Import numpy and pandas

In [1]:

```
import pandas as pd
import numpy as np
```

Import visualization libraries and set %matplotlib inline.

In [2]:

```
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 [4]:

```
df=pd.read_csv('911.csv')
```

Check the info() of the df

In [5]:
```
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 [6]:
```
df.head()
```

Out[6]:

	lat	lng	desc	zip	title	timeStamp	twp	
0	40.297876	-75.581294	REINDEER CT & DEAD END; NEW HANOVER; Station ...	19525.0	EMS: BACK PAINS/INJURY	2015-12-10 17:40:00	NEW HANOVER	REIN & D
1	40.258061	-75.264680	BRIAR PATH & WHITEMARSH LN; HATFIELD TOWNSHIP...	19446.0	EMS: DIABETIC EMERGENCY	2015-12-10 17:40:00	HATFIELD TOWNSHIP	BRIA WHI
2	40.121182	-75.351975	HAWS AVE; NORRISTOWN; 2015-12-10 @ 14:39:21-St...	19401.0	Fire: GAS-ODOR/LEAK	2015-12-10 17:40:00	NORRISTOWN	H
3	40.116153	-75.343513	AIRY ST & SWEDE ST; NORRISTOWN; Station 308A;...	19401.0	EMS: CARDIAC EMERGENCY	2015-12-10 17:40:01	NORRISTOWN	S
4	40.251492	-75.603350	CHERRYWOOD CT & DEAD END; LOWER POTTSGROVE; S...	NaN	EMS: DIZZINESS	2015-12-10 17:40:01	LOWER POTTSGROVE	CHER C

Basic Questions

What are the top 5 zipcodes for 911 calls?

```
In [7]: df['zip'].value_counts().head(5)
```

```
Out[7]: 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 [8]: df['twp'].value_counts().head(5)
```

```
Out[8]: 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 [9]: df['title'].nunique()
```

```
Out[9]: 110
```

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 [10]: 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 [11]: df['Reason'].value_counts()
```

```
Out[11]: EMS        48877
         Traffic    35695
         Fire       14920
         Name: Reason, dtype: int64
```

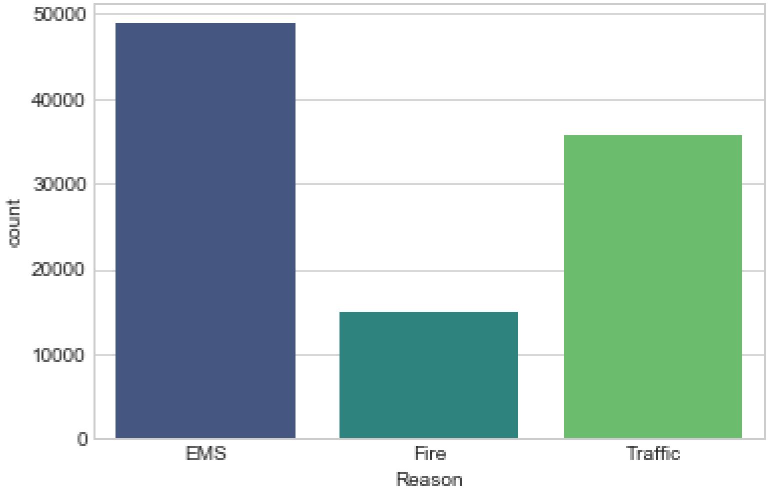
Now use seaborn to create a countplot of 911 calls by Reason.

In [12]:

```
sns.countplot(x='Reason',data=df,palette='viridis')
```

Out[12]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x5334320>
```



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

In [13]:

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

Out[13]:

```
str
```

You should have seen that these timestamps are still strings. Use [pd.to_datetime (http://pandas.pydata.org/pandas-docs/stable/generated/pandas.to_datetime.html)](http://pandas.pydata.org/pandas-docs/stable/generated/pandas.to_datetime.html) to convert the column from strings to DateTime objects.

In [14]:

```
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 [15]:

```
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 [16]:
```
dmap = {0:'Mon',1:'Tue',2:'Wed',3:'Thu',4:'Fri',5:'Sat',6:'Sun'}
```

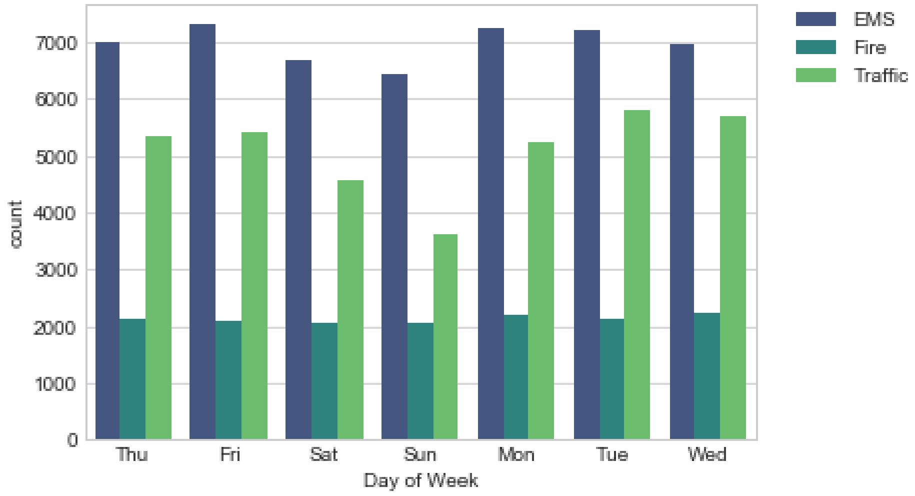
In [17]:
```
df['Day of Week'] = df['Day of Week'].map(dmap)
```

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

In [18]:
```
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[18]:
```
<matplotlib.legend.Legend at 0xab16470>
```

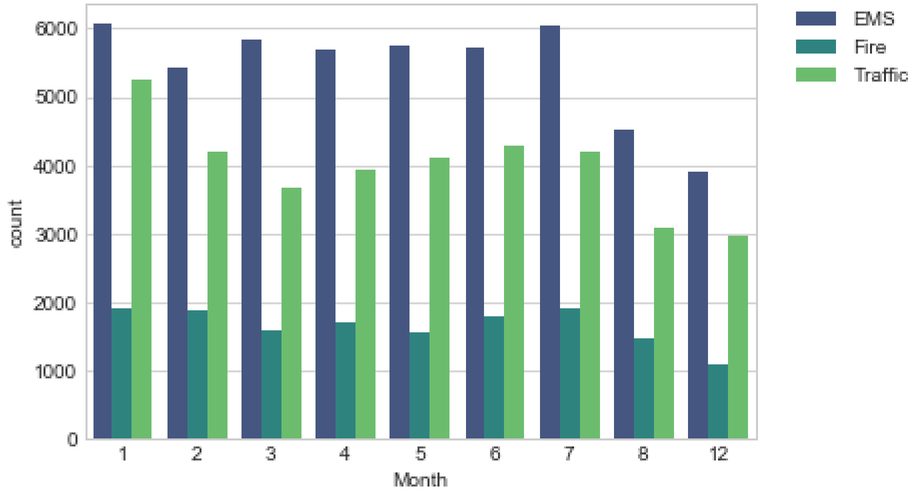


Now do the same for Month:

```
In [19]: 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[19]: <matplotlib.legend.Legend at 0xae9de80>
```



Did you notice something strange about the Plot?

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

Out[169]:

	lat	lng	desc	zip	title	timeStamp	twp	addr	e	Reason	Hour	Da Wee
Month												
1	13205	13205	13205	11527	13205	13205	13203	13096	13205	13205	13205	1320
2	11467	11467	11467	9930	11467	11467	11465	11396	11467	11467	11467	1146
3	11101	11101	11101	9755	11101	11101	11092	11059	11101	11101	11101	1110
4	11326	11326	11326	9895	11326	11326	11323	11283	11326	11326	11326	1132
5	11423	11423	11423	9946	11423	11423	11420	11378	11423	11423	11423	1142

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

In [20]:
```
byMonth = df.groupby('Month').count()
byMonth.head()
```

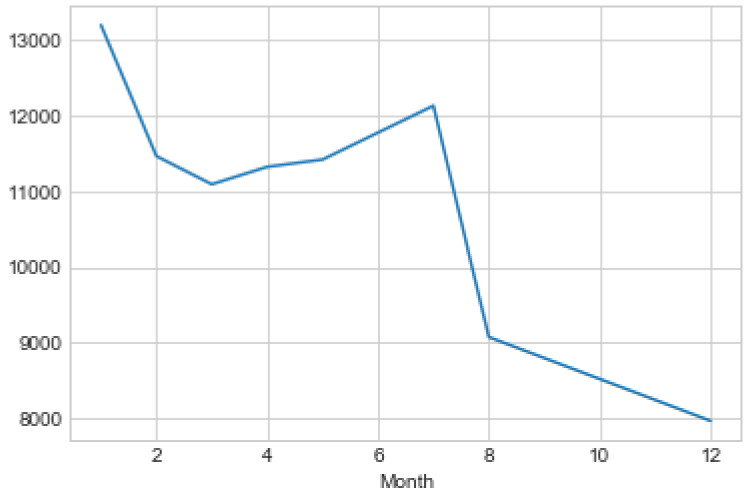
Out[20]:

	lat	lng	desc	zip	title	timeStamp	twp	addr	e	Reason	Hour	Da Wee
Month												
1	13205	13205	13205	11527	13205	13205	13203	13096	13205	13205	13205	1320
2	11467	11467	11467	9930	11467	11467	11465	11396	11467	11467	11467	1146
3	11101	11101	11101	9755	11101	11101	11092	11059	11101	11101	11101	1110
4	11326	11326	11326	9895	11326	11326	11323	11283	11326	11326	11326	1132
5	11423	11423	11423	9946	11423	11423	11420	11378	11423	11423	11423	1142

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.

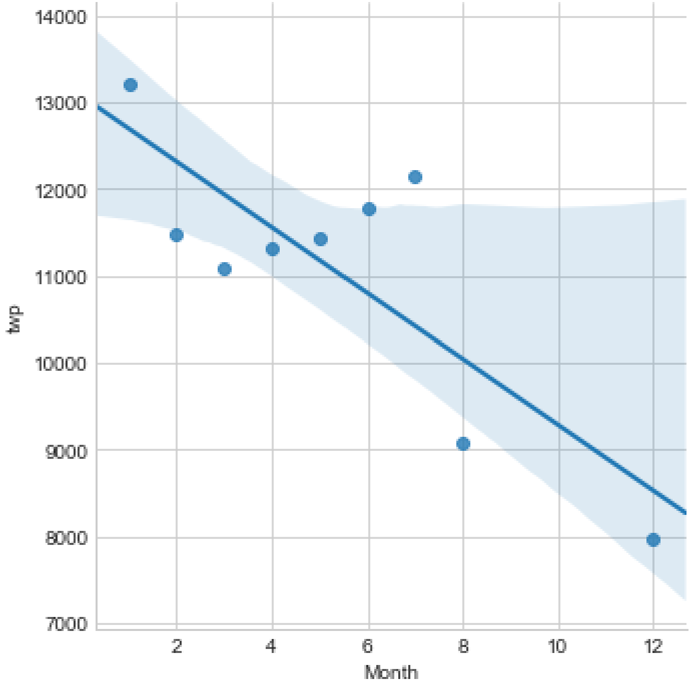
In [21]:
```
# Could be any column
byMonth['twp'].plot()
```

Out[21]:
```
<matplotlib.axes._subplots.AxesSubplot at 0xaf48438>
```



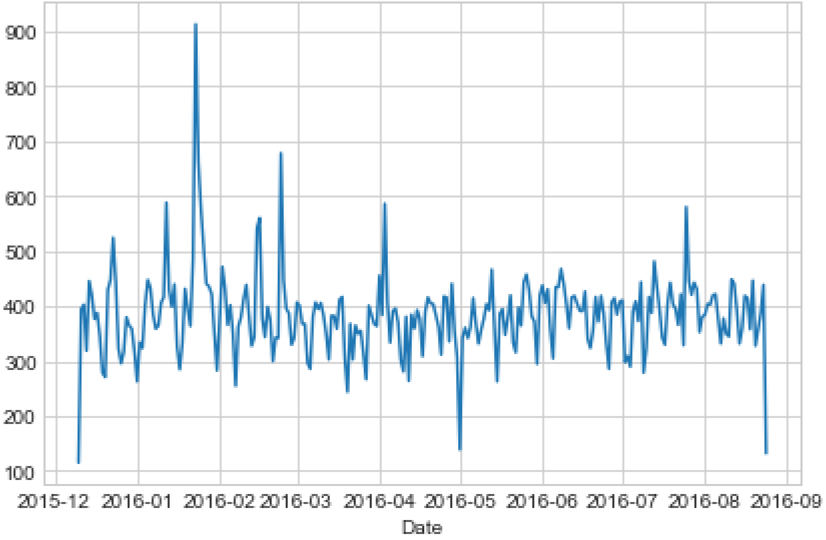
Create a new column called 'Date' that contains the date from the timeStamp column. You'll need to use apply along with the .date() method.

In [23]:
```
sns.lmplot(x='Month',y='twp',data=byMonth.reset_index())
df['Date']=df['timeStamp'].apply(lambda t: t.date())
```



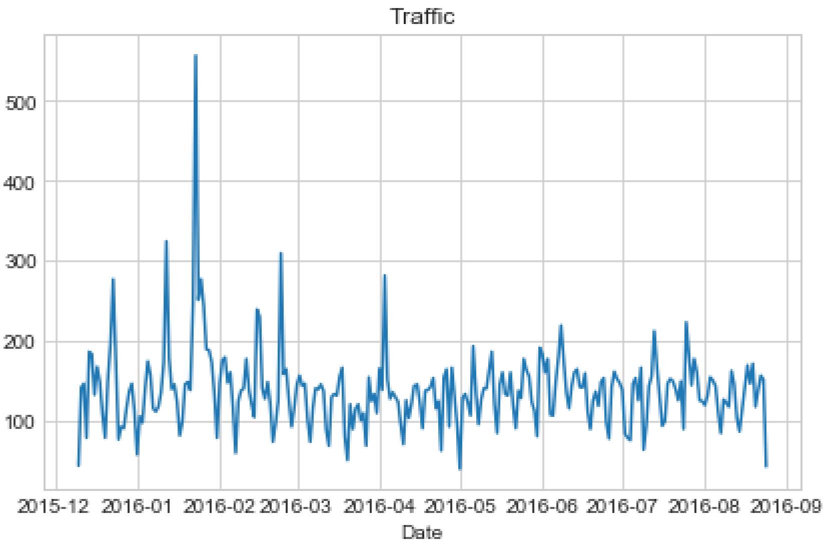
Now groupby this Date column with the count() aggregate and create a plot of counts of 911 calls.

In [24]:
```
df.groupby('Date').count()['twp'].plot()
plt.tight_layout()
```

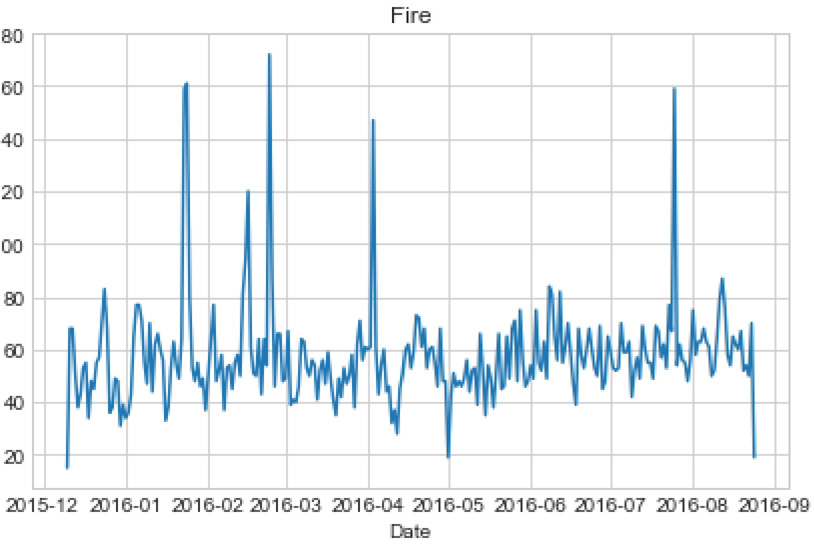


Now recreate this plot but create 3 separate plots with each plot representing a Reason for the 911 call

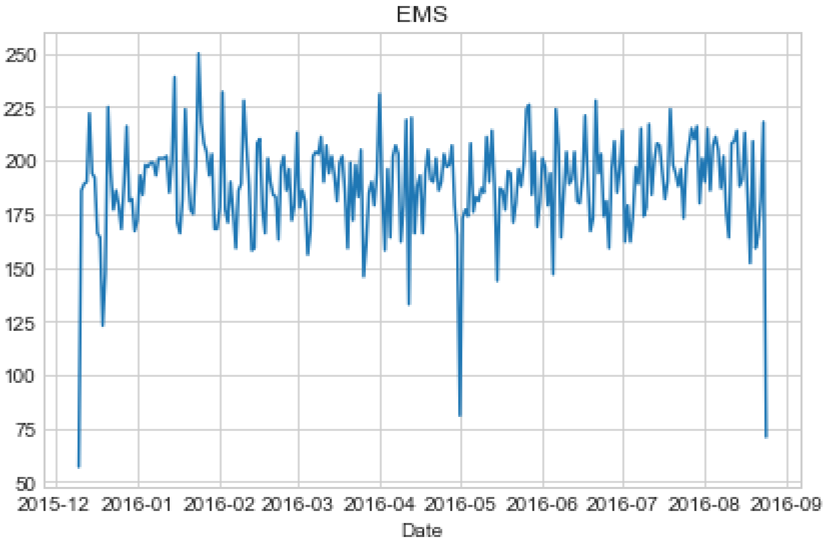
In [25]:
```
df[df['Reason']=='Traffic'].groupby('Date').count()['twp'].plot()
plt.title('Traffic')
plt.tight_layout()
```



In [26]:
```
df[df['Reason']=='Fire'].groupby('Date').count()['twp'].plot()
plt.title('Fire')
plt.tight_layout()
```



In [27]:
```
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 (http://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.unstack.html)](http://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.unstack.html) method. Reference the solutions if you get stuck on this!

In [28]:
```
dayHour = df.groupby(by=['Day of Week','Hour']).count()['Reason'].unstack()
dayHour.head()
```

Out[28]:

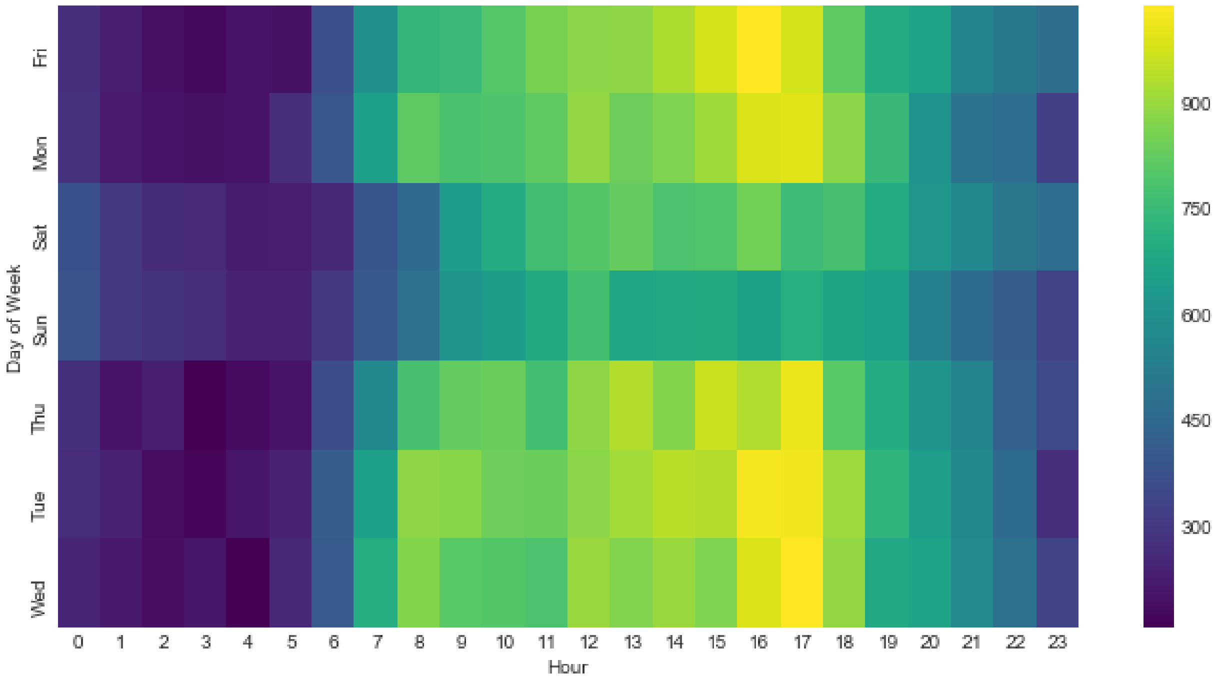
Hour	0	1	2	3	4	5	6	7	8	9	...	14	15	16	17	18	19	
Day of Week																		
Fri	275	235	191	175	201	194	372	598	742	752	...	932	980	1039	980	820	696	6
Mon	282	221	201	194	204	267	397	653	819	786	...	869	913	989	997	885	746	6
Sat	375	301	263	260	224	231	257	391	459	640	...	789	796	848	757	778	696	6
Sun	383	306	286	268	242	240	300	402	483	620	...	684	691	663	714	670	655	5
Thu	278	202	233	159	182	203	362	570	777	828	...	876	969	935	1013	810	698	6

5 rows × 24 columns

Now create a HeatMap using this new DataFrame.

In [29]:
```
plt.figure(figsize=(12,6))
sns.heatmap(dayHour,cmap='viridis')
```

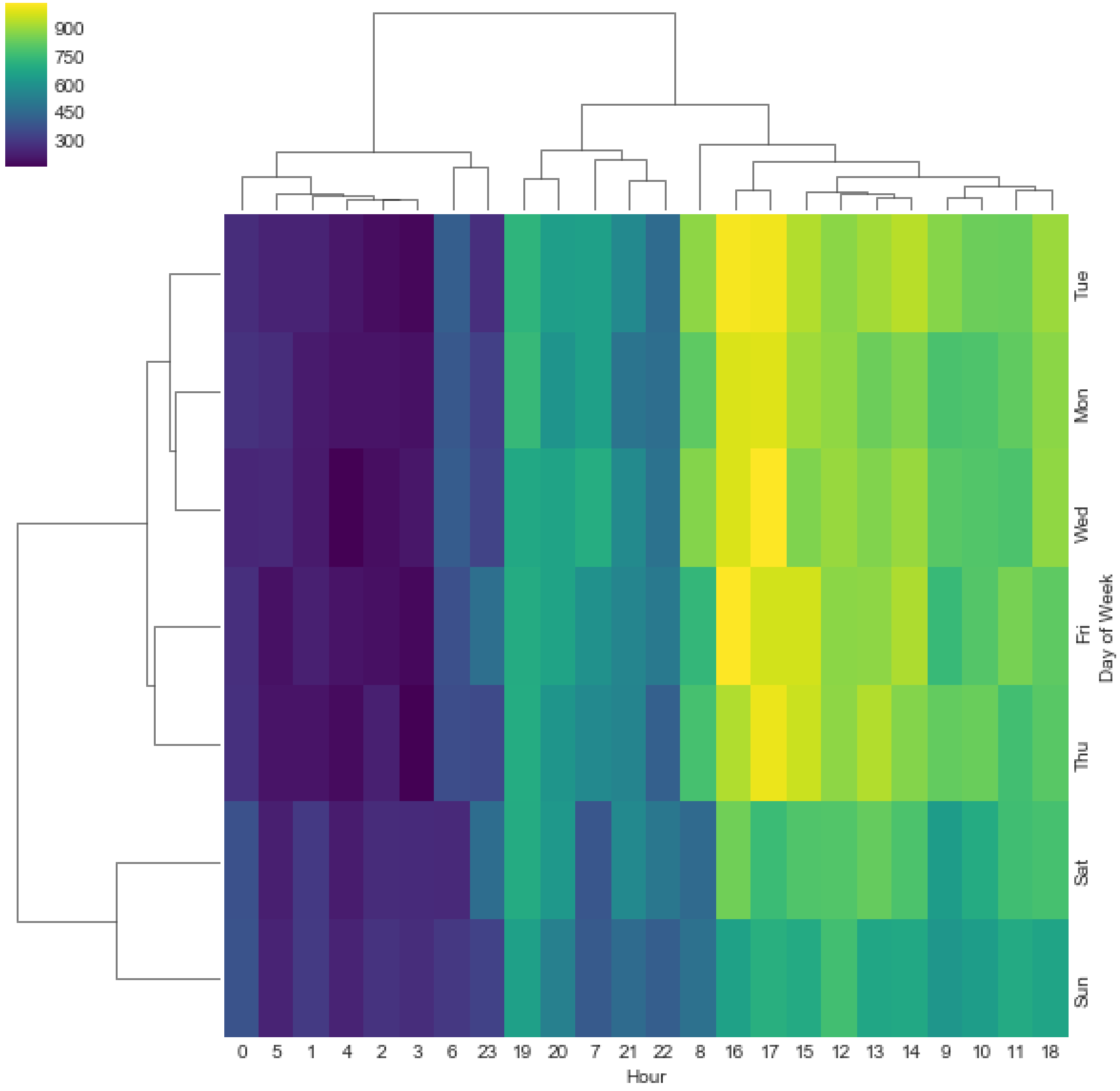
Out[29]:
```
<matplotlib.axes._subplots.AxesSubplot at 0xafe9438>
```



Now create a clustermap using this DataFrame.

```
In [30]: sns.clustermap(dayHour,cmap='viridis')
```

```
Out[30]: <seaborn.matrix.ClusterGrid at 0xb128d68>
```



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

In [31]:

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

Out[31]:

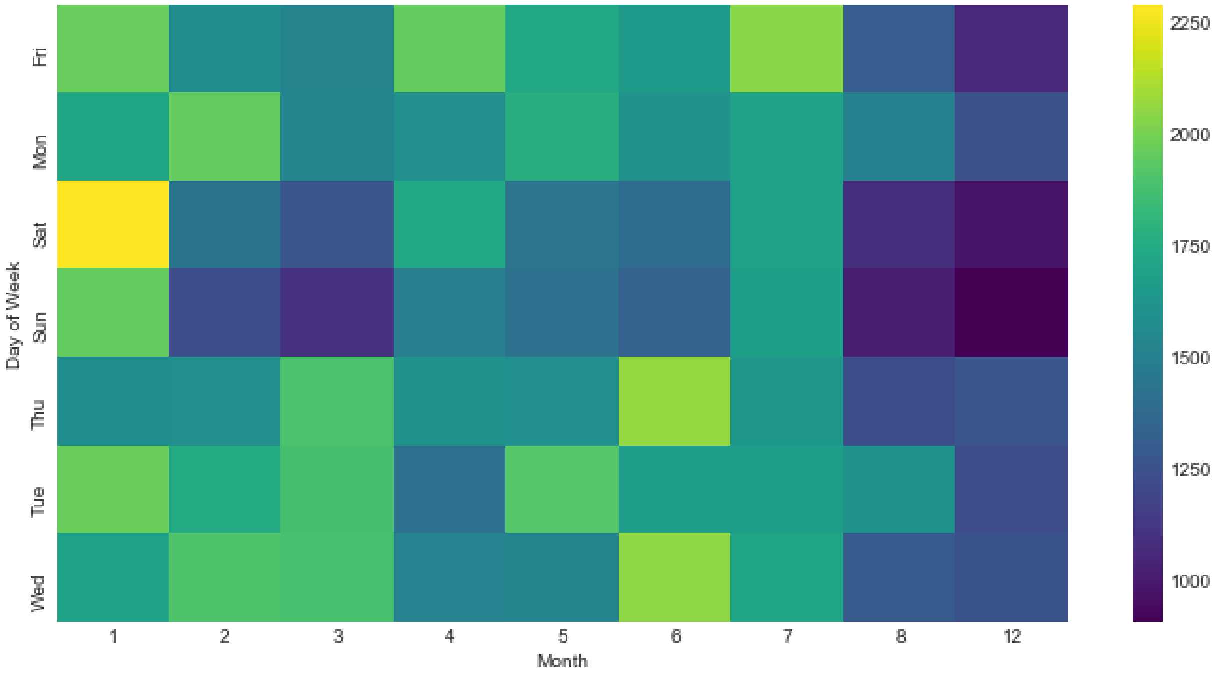
```
      Month     1     2     3     4     5     6     7     8    12
Day of Week
        Fri  1970  1581  1525  1958  1730  1649  2045  1310  1065
        Mon  1727  1964  1535  1598  1779  1617  1692  1511  1257
        Sat  2291  1441  1266  1734  1444  1388  1695  1099   978
        Sun  1960  1229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

In [32]:

```
plt.figure(figsize=(12,6))
sns.heatmap(dayMonth,cmap='viridis')
```

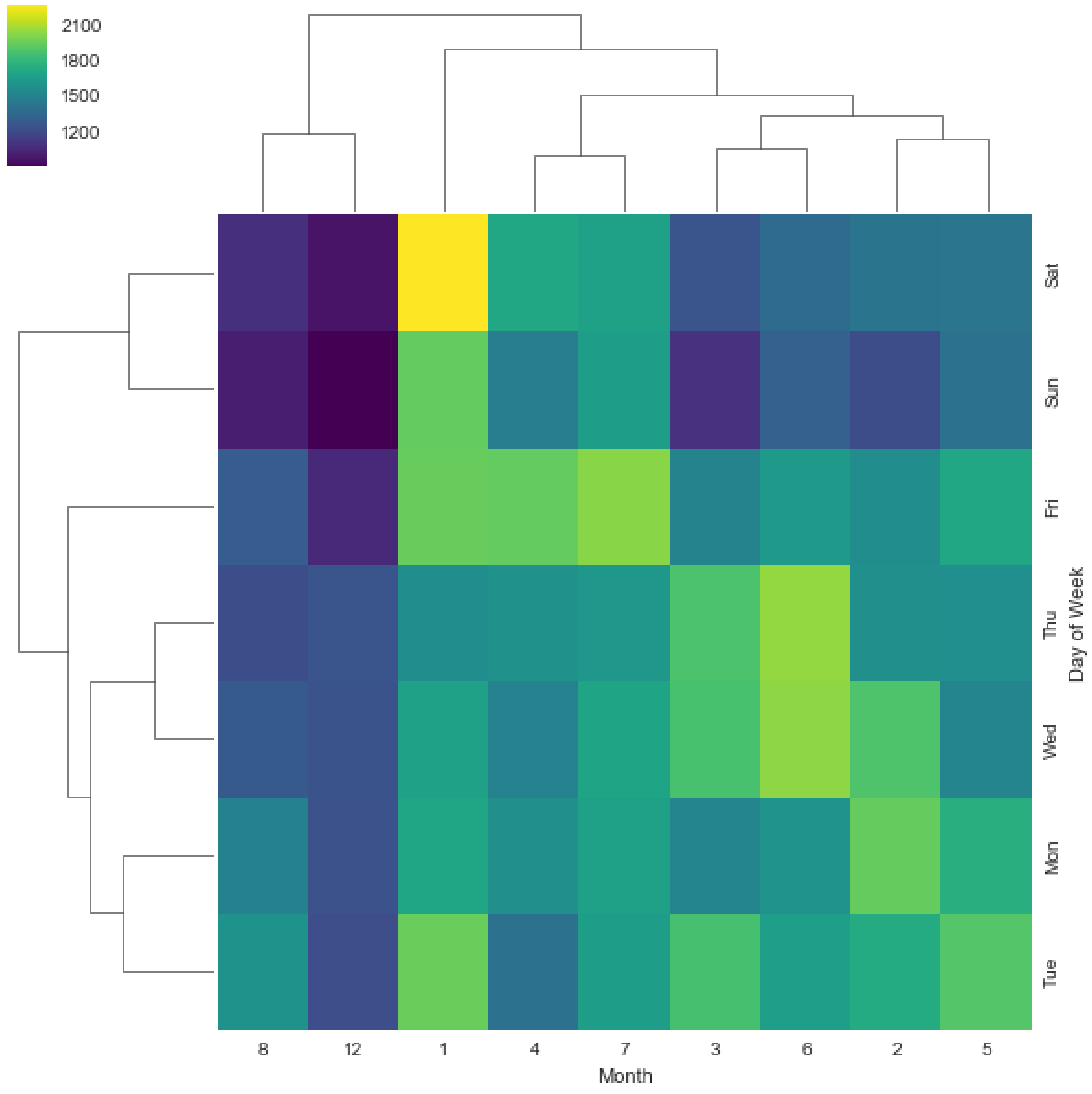
Out[32]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xb4a7128>
```



```
In [209]:
```

```
Out[209]: <seaborn.matrix.ClusterGrid at 0x12a1a61d0>
```



Continue exploring the Data however you see fit!

Great Job!