911 Calls Capstone Project

For this capstone project I have used to analyze some 911 call data from Kaggle.

Data and Setup

In [31]:
```
import numpy as np
import pandas as pd
import seaborn as sns
```

In [32]:
```
import matplotlib.pyplot as plt
import seaborn as sns
sns.set_style('whitegrid')
%matplotlib inline
```

Reading CSV file as a dataframe called df

In [33]:
```
df = pd.read_csv('911.csv')
```

Checking the dataset

In [53]:
```
df
```

Out[53]:

	lat	lng	desc	zip	title	timeStamp	twp	addr	e	Reason	Hour	Month	Day of Week
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	REINDEER CT & DEAD END	1	EMS	17	12	3
1	40.258061	-75.264680	BRIAR PATH & WHITEMARSH LN; HATFIELD TOWNSHIP...	19446.0	EMS: DIABETIC EMERGENCY	2015-12-10 17:40:00	HATFIELD TOWNSHIP	BRIAR PATH & WHITEMARSH LN	1	EMS	17	12	3
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	HAWS AVE	1	Fire	17	12	3
3	40.116153	-75.343513	AIRY ST & SWEDE ST; NORRISTOWN; Station 308A;...	19401.0	EMS: CARDIAC EMERGENCY	2015-12-10 17:40:01	NORRISTOWN	AIRY ST & SWEDE ST	1	EMS	17	12	3
4	40.251492	-75.603350	CHERRYWOOD CT & DEAD END; LOWER POTTSGROVE; S...	NaN	EMS: DIZZINESS	2015-12-10 17:40:01	LOWER POTTSGROVE	CHERRYWOOD CT & DEAD END	1	EMS	17	12	3
...	...	...	...	...	...	...	...	...	...	...	...	...	...
99487	40.132869	-75.333515	MARKLEY ST & W LOGAN ST; NORRISTOWN; 2016-08-2...	19401.0	Traffic: VEHICLE ACCIDENT -	2016-08-24 11:06:00	NORRISTOWN	MARKLEY ST & W LOGAN ST	1	Traffic	11	8	2
99488	40.006974	-75.289080	LANCASTER AVE & RITTENHOUSE PL; LOWER MERION; ...	19003.0	Traffic: VEHICLE ACCIDENT -	2016-08-24 11:07:02	LOWER MERION	LANCASTER AVE & RITTENHOUSE PL	1	Traffic	11	8	2
99489	40.115429	-75.334679	CHESTNUT ST & WALNUT ST; NORRISTOWN; Station ...	19401.0	EMS: FALL VICTIM	2016-08-24 11:12:00	NORRISTOWN	CHESTNUT ST & WALNUT ST	1	EMS	11	8	2
99490	40.186431	-75.192555	WELSH RD & WEBSTER LN; HORSHAM; Station 352; ...	19002.0	EMS: NAUSEA/VOMITING	2016-08-24 11:17:01	HORSHAM	WELSH RD & WEBSTER LN	1	EMS	11	8	2
99491	40.207055	-75.317952	MORRIS RD & S BROAD ST; UPPER GWYNEDD; 2016-08...	19446.0	Traffic: VEHICLE ACCIDENT -	2016-08-24 11:17:02	UPPER GWYNEDD	MORRIS RD & S BROAD ST	1	Traffic	11	8	2

99492 rows × 13 columns

Checking the info() of the df

In [35]:
```
df.info()
```

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

Checking the head of df

In [36]:
```
df.head()
```

Out[36]:

	lat	lng	desc	zip	title	timeStamp	twp	addr	e
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	REINDEER CT & DEAD END	1
1	40.258061	-75.264680	BRIAR PATH & WHITEMARSH LN; HATFIELD TOWNSHIP...	19446.0	EMS: DIABETIC EMERGENCY	2015-12-10 17:40:00	HATFIELD TOWNSHIP	BRIAR PATH & WHITEMARSH LN	1
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	HAWS AVE	1
3	40.116153	-75.343513	AIRY ST & SWEDE ST; NORRISTOWN; Station 308A;...	19401.0	EMS: CARDIAC EMERGENCY	2015-12-10 17:40:01	NORRISTOWN	AIRY ST & SWEDE ST	1
4	40.251492	-75.603350	CHERRYWOOD CT & DEAD END; LOWER POTTSGROVE; S...	NaN	EMS: DIZZINESS	2015-12-10 17:40:01	LOWER POTTSGROVE	CHERRYWOOD CT & DEAD END	1

Counting Unique Values

What are the top 5 zipcodes for 911 calls?

In [37]:
```
df['zip'].value_counts().head(5)
```

Out[37]:
```
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 [38]:
```
df['twp'].value_counts().head(5)
```

Out[38]:
```
LOWER MERION    8443
ABINGTON        5977
NORRISTOWN      5890
UPPER MERION    5227
CHELTENHAM      4575
Name: twp, dtype: int64
```

how many unique title codes are there?

In [39]:
```
df['title'].nunique()
```

Out[39]:
```
110
```

Finding Reasons Data

In the data there are "Reasons/Departments" specified before the title code. These are EMS, Fire, and Traffic. Using .apply() function 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 [40]:
```
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?

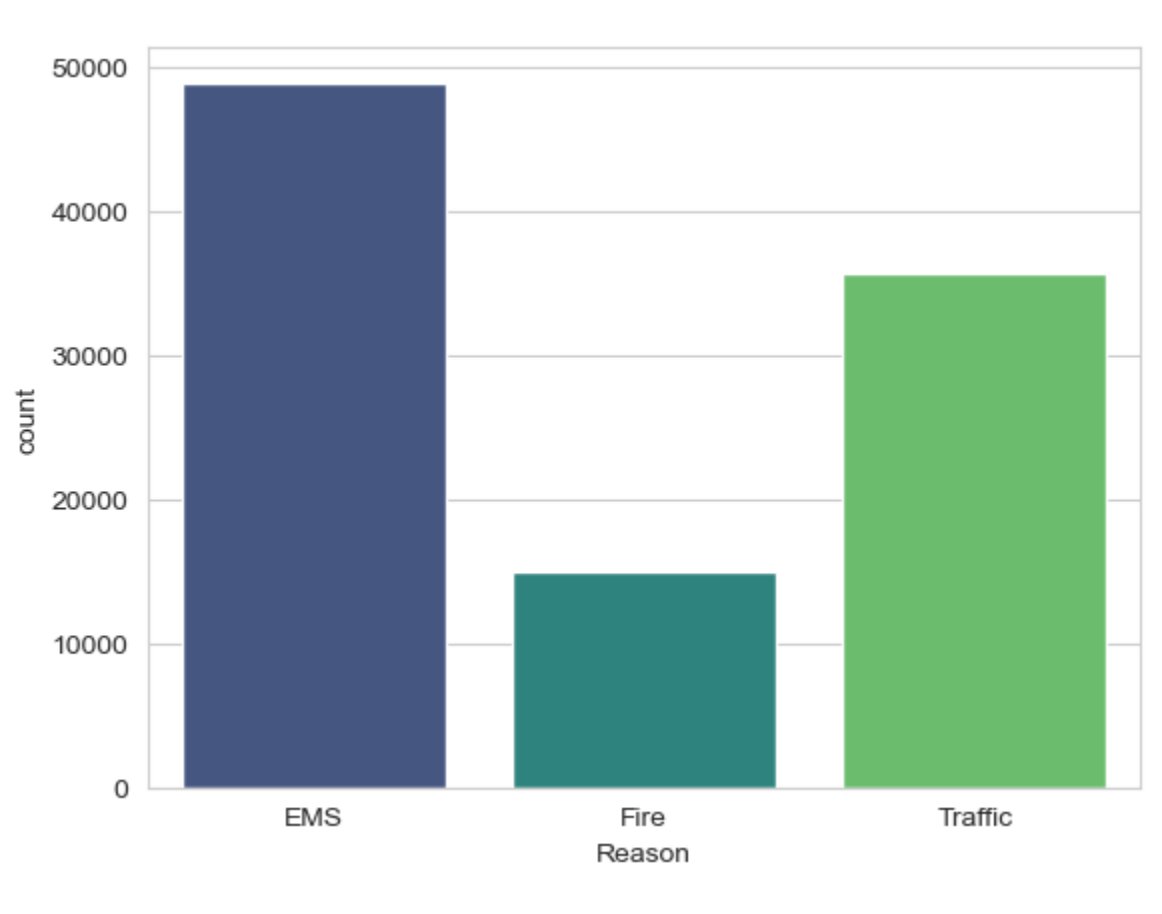
In [41]:
```
df['Reason'].value_counts()
```

Out[41]:
```
EMS        48877
Traffic    35695
Fire       14920
Name: Reason, dtype: int64
```

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

In [42]:
```
sns.countplot(data=df,x='Reason',palette='viridis')
```

Out[42]:
```
<Axes: xlabel='Reason', ylabel='count'>
```



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

In [43]:
```
type(df['timeStamp'].iloc[0])
```

Out[43]:
```
str
```

You should have seen that these timestamps are still strings. Now I need to convert the column from strings to DateTime objects.

In [72]:
```
df['timeStamp']=pd.to_datetime(df['timeStamp'])
```

Now that the timestamp column are actually DateTime objects, using .apply() function to create 3 new columns called Hour, Month, and Day of Week.

In [52]:
```
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. Using the .map() I am going to create a 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 [46]:
```
dmap = {0:'Mon',1:'Tue',2:'Wed',3:'Thu',4:'Fri',5:'Sat',6:'Sun'}
```

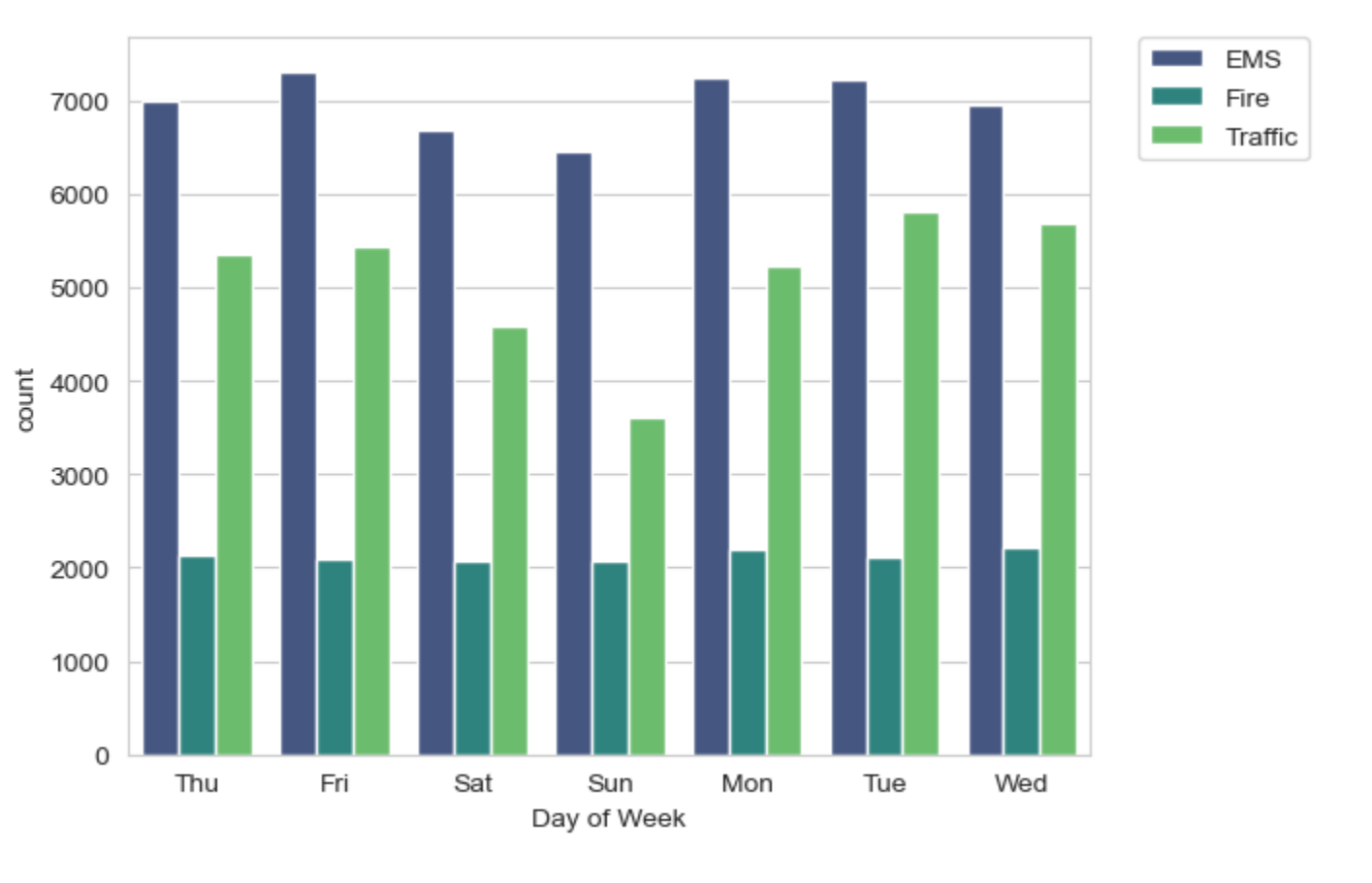
In [47]:
```
df['Day of Week'] = df['Day of Week'].map(dmap)
```

Finding Reasons by Hour, Month, Day of Week

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

In [48]:
```
sns.countplot(data=df,x='Day of Week',hue='Reason',palette='viridis')
plt.legend(bbox_to_anchor=(1.05, 1), loc=2, borderaxespad=0.)
```

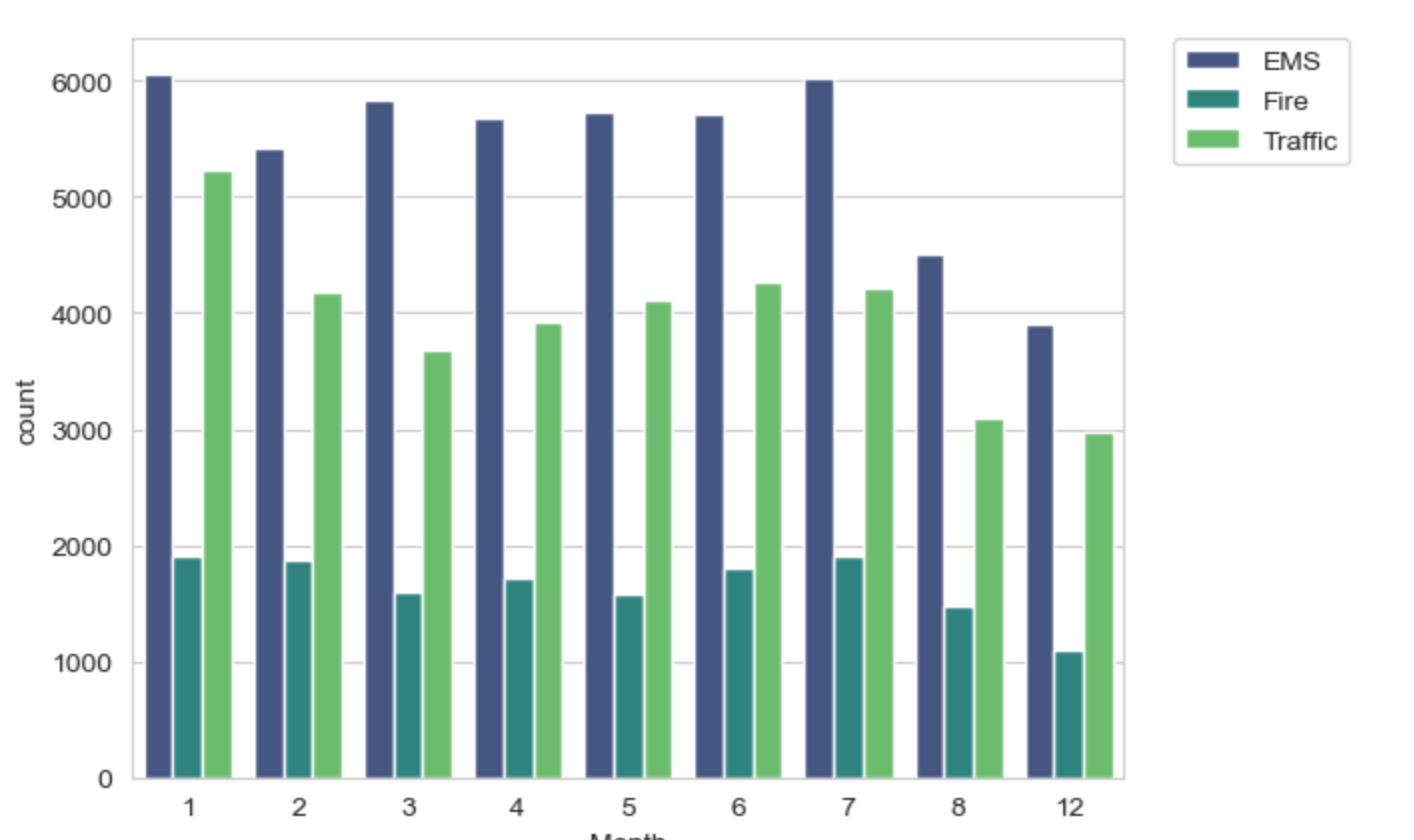
Out[48]:
```
<matplotlib.legend.Legend at 0x275ebccc5b0>
```



Now for Month:

In [49]:
```
sns.countplot(data=df,x='Month',hue='Reason',palette='viridis')
plt.legend(bbox_to_anchor=(1.05, 1), loc=2, borderaxespad=0.)
```

Out[49]:
```
<matplotlib.legend.Legend at 0x275ebcccbb0>
```



Did you notice something strange about the Plot?

In this Month countplot 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.

Now creating a gropuby object called byMonth, you can group the DataFrame by the month column and by using the count() method for aggregation.

In [50]:
```
byMonth = df.groupby('Month').count()
byMonth.head()
```

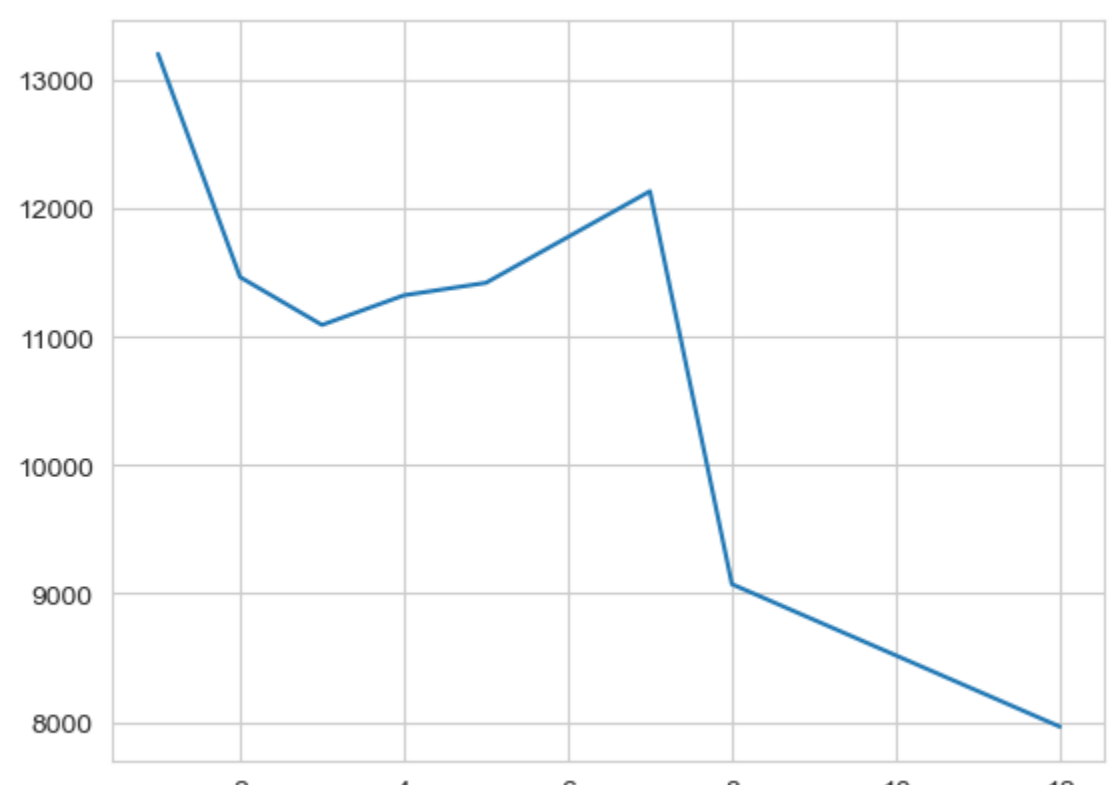
Out[50]:

	lat	lng	desc	zip	title	timeStamp	twp	addr	e	Reason	Hour	Day of Week
Month												
1	13205	13205	13205	11527	13205	13205	13203	13096	13205	13205	13205	13205
2	11467	11467	11467	9930	11467	11467	11465	11396	11467	11467	11467	11467
3	11101	11101	11101	9755	11101	11101	11092	11059	11101	11101	11101	11101
4	11326	11326	11326	9895	11326	11326	11323	11283	11326	11326	11326	11326
5	11423	11423	11423	9946	11423	11423	11420	11378	11423	11423	11423	11423

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

In [54]:
```
byMonth['twp'].plot()
```

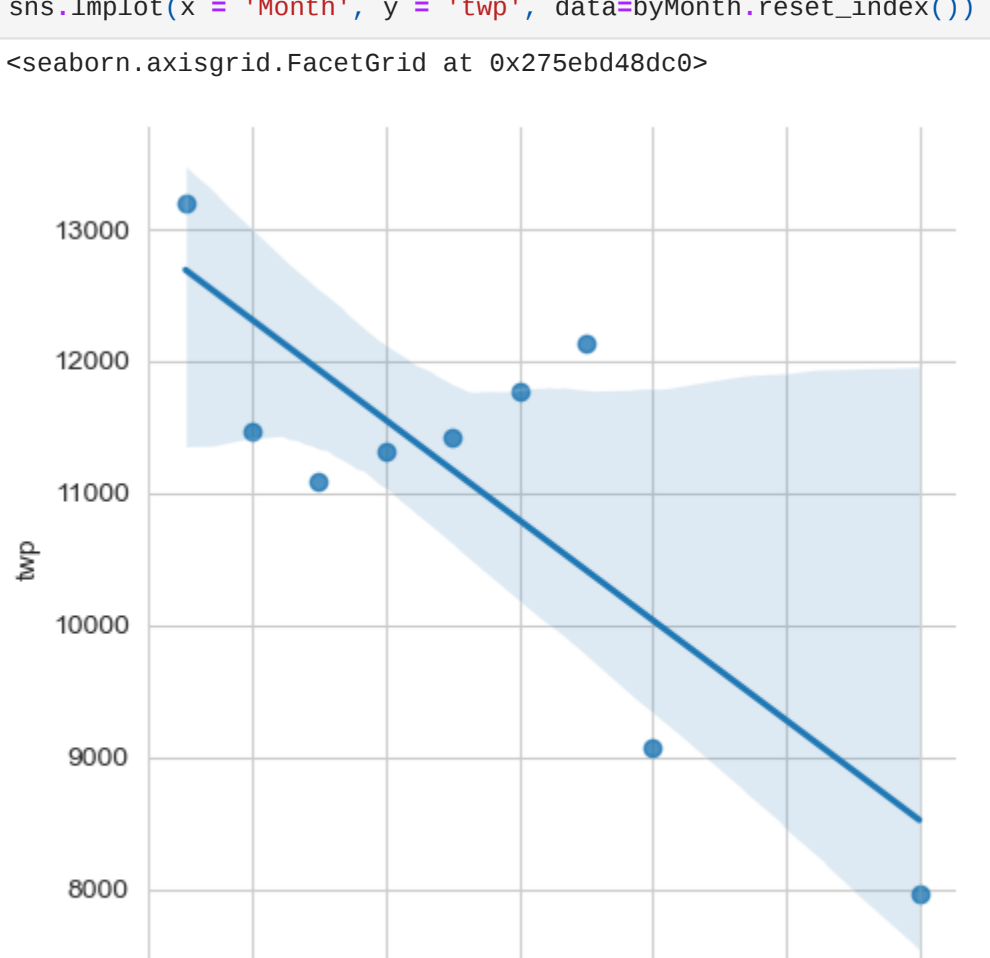
Out[54]:
```
<Axes: xlabel='Month'>
```



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

In [55]:
```
sns.lmplot(x = 'Month', y = 'twp', data=byMonth.reset_index())
```

Out[55]:
```
<seaborn.axisgrid.FacetGrid at 0x275ebd48dc0>
```

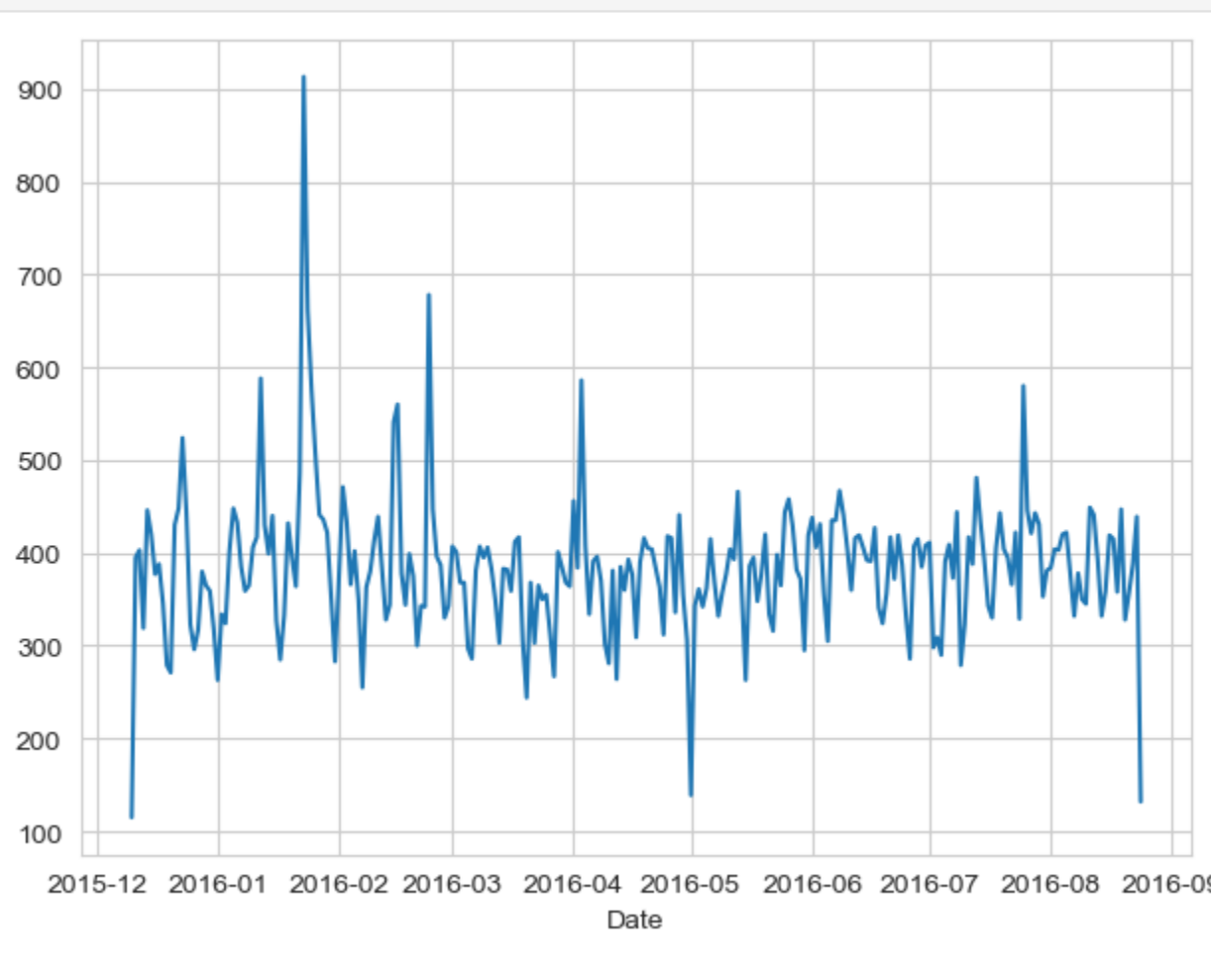


Creating a new column called 'Date' that contains the date from the timeStamp column. Which will visualize the 911 call data more clearly

In [56]:
```
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 [59]:
```
df.groupby('Date').count()['twp'].plot()
plt.tight_layout()
```

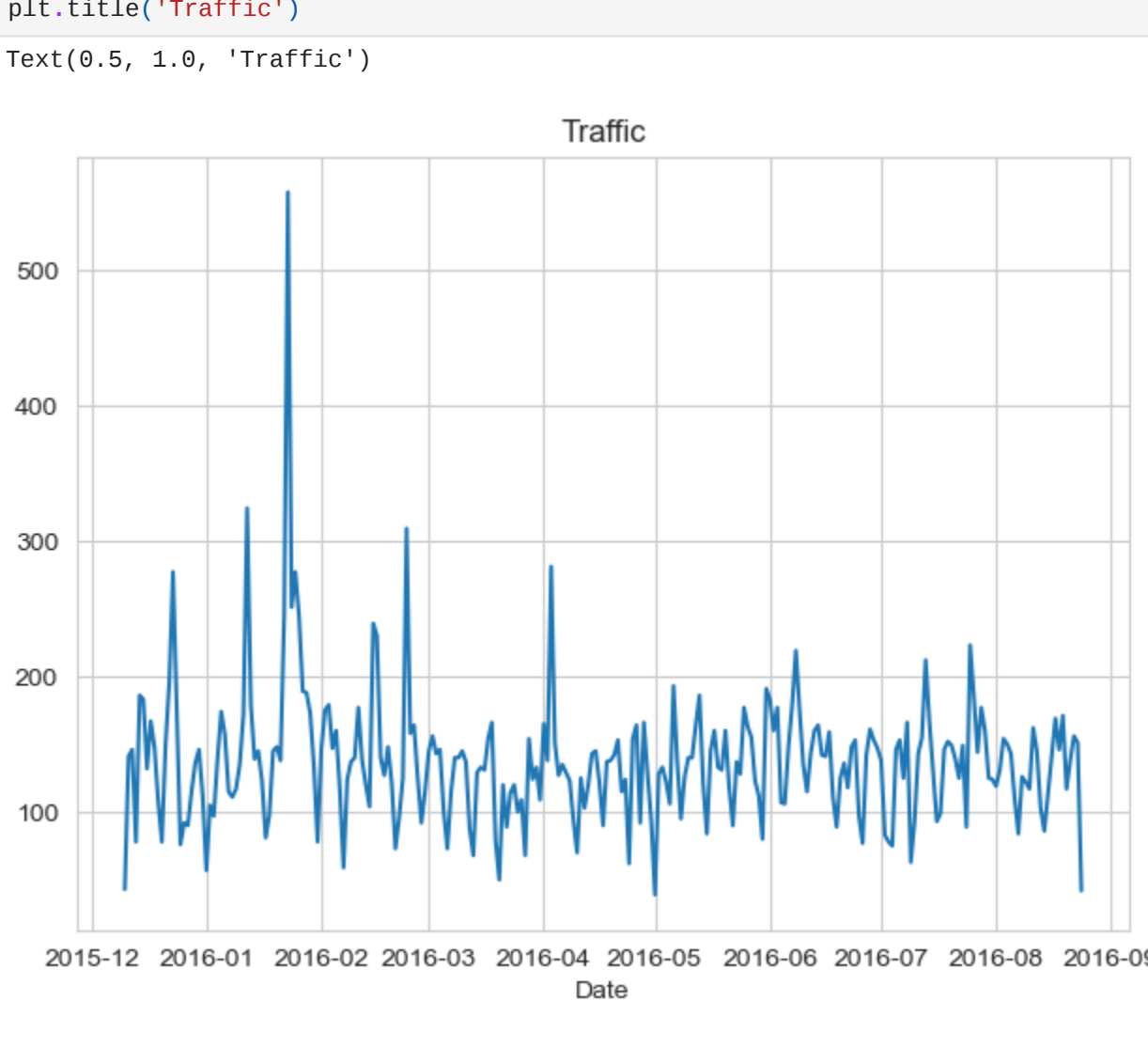


Finding Reason by Date wise

Now recreating this plot by creating 3 separate plots with each plot representing a Reason for the 911 call

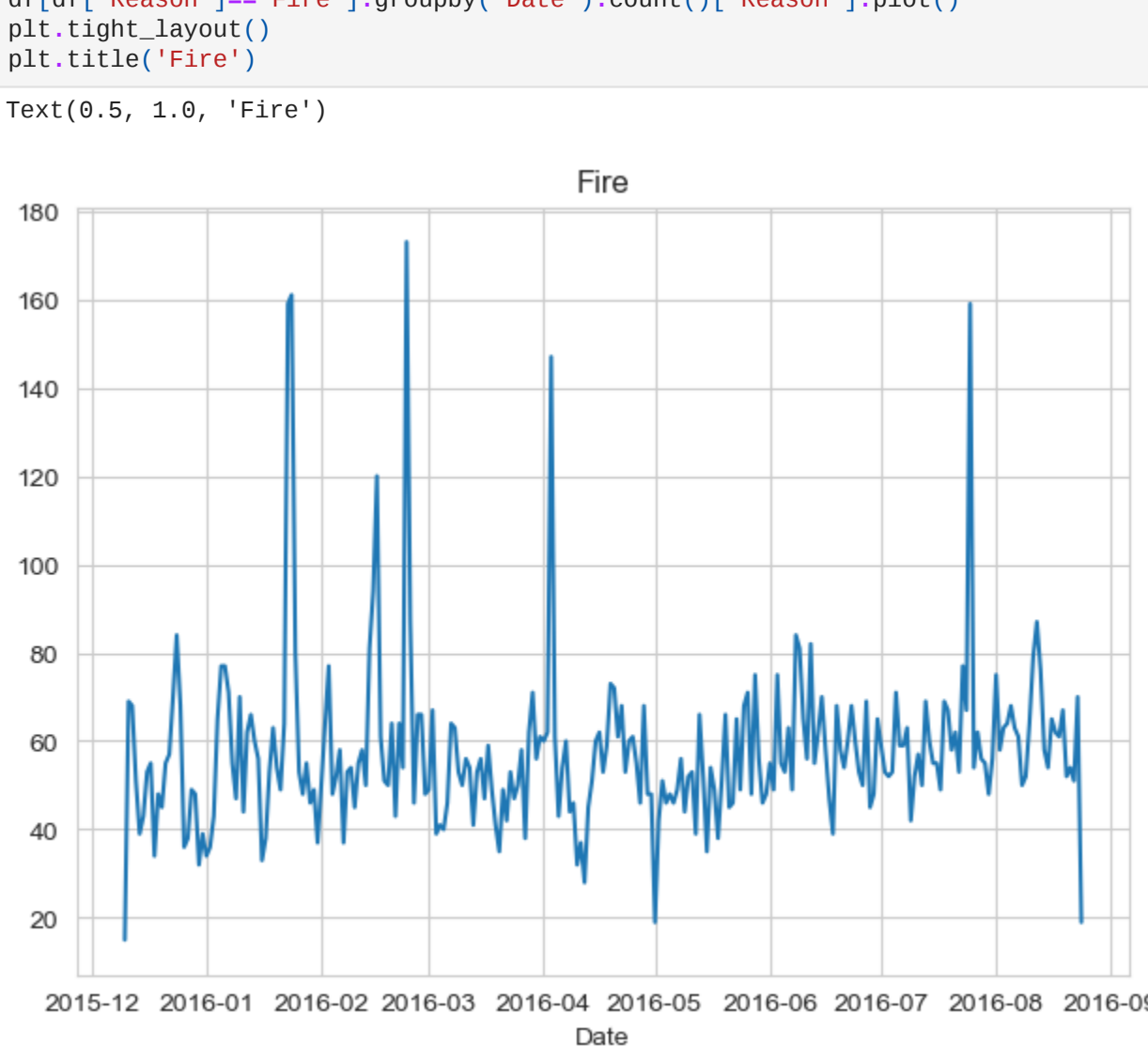
In [60]:
```
df[df['Reason']=='Traffic'].groupby('Date').count()['Reason'].plot()
plt.tight_layout()
plt.title('Traffic')
```

Out[60]:
```
Text(0.5, 1.0, 'Traffic')
```



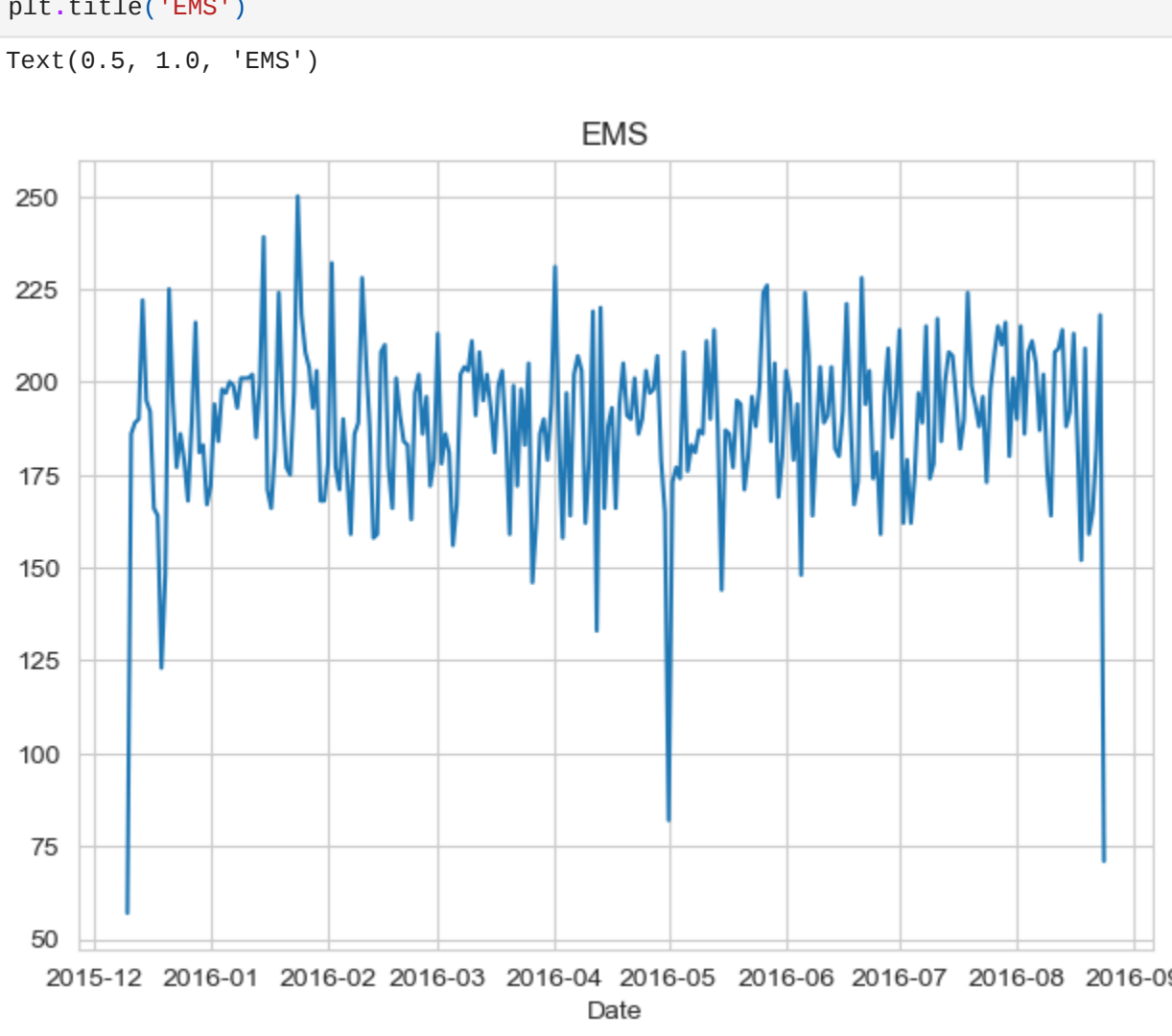
In [61]:
```
df[df['Reason']=='Fire'].groupby('Date').count()['Reason'].plot()
plt.tight_layout()
plt.title('Fire')
```

Out[61]:
```
Text(0.5, 1.0, 'Fire')
```



In [62]:
```
df[df['Reason']=='EMS'].groupby('Date').count()['Reason'].plot()
plt.tight_layout()
plt.title('EMS')
```

Out[62]:
```
Text(0.5, 1.0, 'EMS')
```



Finding Reason by Day of week and Hour

Now to know more by hourly and day wise.For that I need to use heat map. We'll first need to restructure the dataframe so that the columns become the Hours and the Index becomes the Day of the Week.

In [65]:
```
dayHour = df.groupby(by = ['Day of Week', 'Hour']).count()['Reason'].unstack()
dayHour.head()
```

Out[65]:

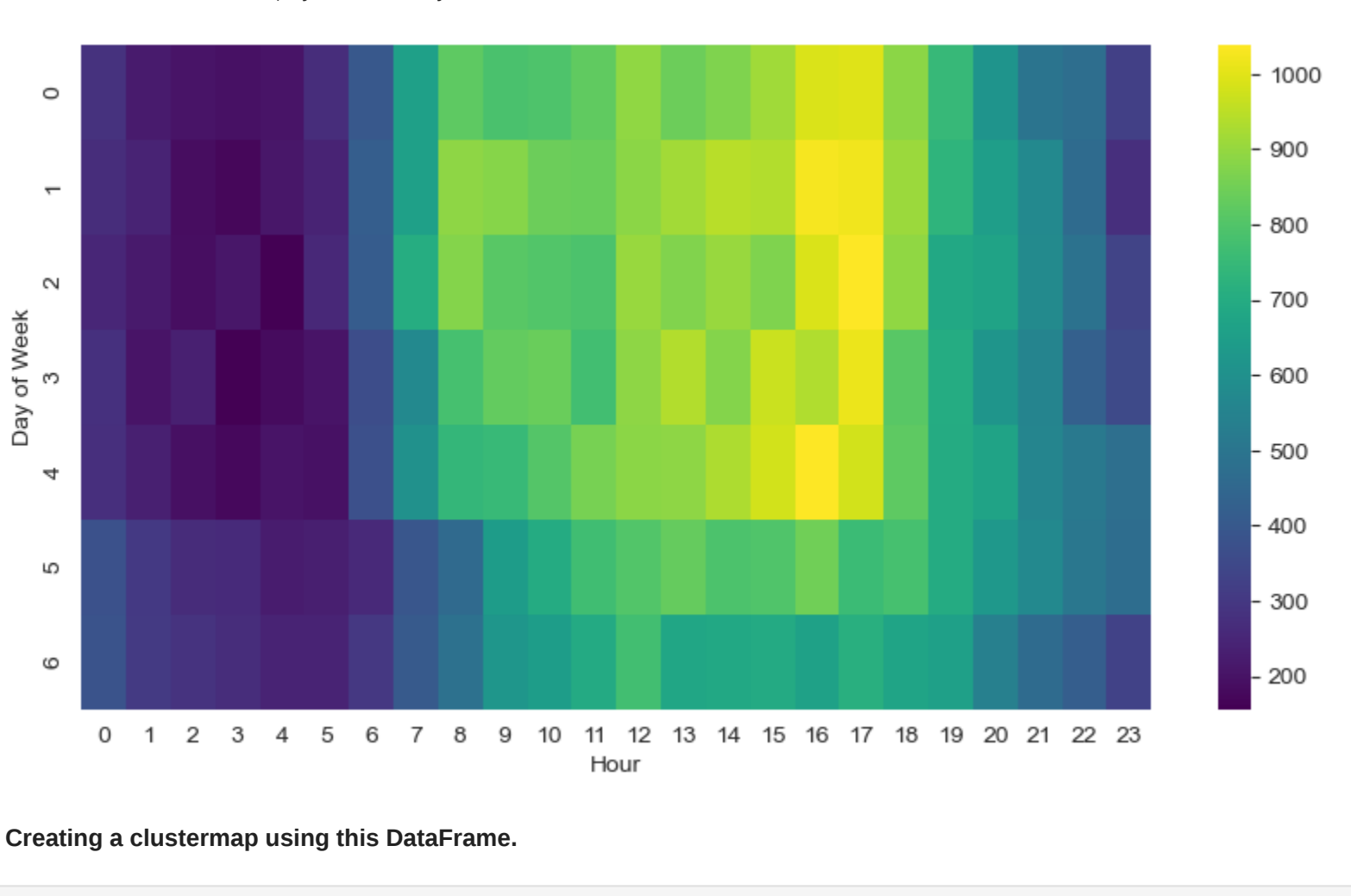
Hour	0	1	2	3	4	5	6	7	8	9	...	14	15	16	17	18	19	20	21	22	23
Day of Week																					
0	282	221	201	194	204	267	397	653	819	786	...	869	913	989	997	885	746	613	497	472	325
1	269	240	186	170	209	239	415	655	889	880	...	943	938	1026	1019	905	731	647	571	462	274
2	250	216	189	209	156	255	410	701	875	808	...	904	867	990	1037	894	686	668	575	490	335
3	278	202	233	159	182	203	362	570	777	828	...	876	969	935	1013	810	698	617	553	424	354
4	275	235	191	175	201	194	372	598	742	752	...	932	980	1039	980	820	696	667	559	514	474

5 rows × 24 columns

creating a HeatMap using this new DataFrame.

In [66]:
```
plt.figure(figsize=(10,5))
sns.heatmap(dayHour,cmap='viridis')
```

Out[66]:
```
<Axes: xlabel='Hour', ylabel='Day of Week'>
```

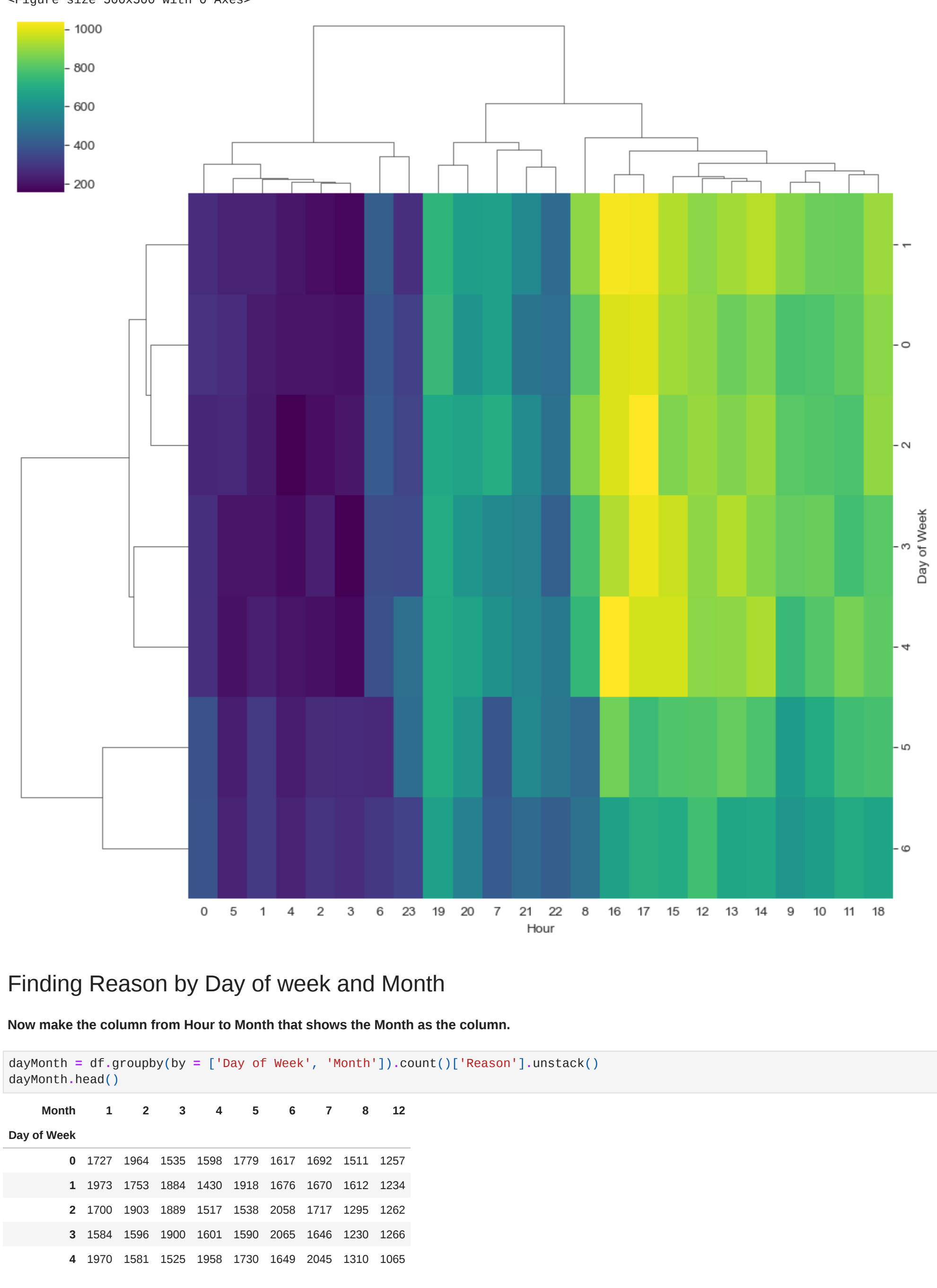


Creating a clustermap using this DataFrame.

In [67]:
```
plt.figure(figsize=(5,5))
sns.clustermap(dayHour,cmap='viridis')
```

Out[67]:
```
<seaborn.matrix.ClusterGrid at 0x275f09fb370>
```

```
<Figure size 500x500 with 0 Axes>
```



Finding Reason by Day of week and Month

Now make the column from Hour to Month that shows the Month as the column.

In [68]:
```
dayMonth = df.groupby(by = ['Day of Week', 'Month']).count()['Reason'].unstack()
dayMonth.head()
```

Out[68]:

Month	1	2	3	4	5	6	7	8	12
Day of Week									
0	1727	1964	1535	1598	1779	1617	1692	1511	1257
1	1973	1753	1884	1430	1918	1676	1670	1612	1234
2	1700	1903	1889	1517	1538	2058	1717	1295	1262
3	1584	1596	1900	1601	1590	2065	1646	1230	1266
4	1970	1581	1525	1958	1730	1649	2045	1310	1065

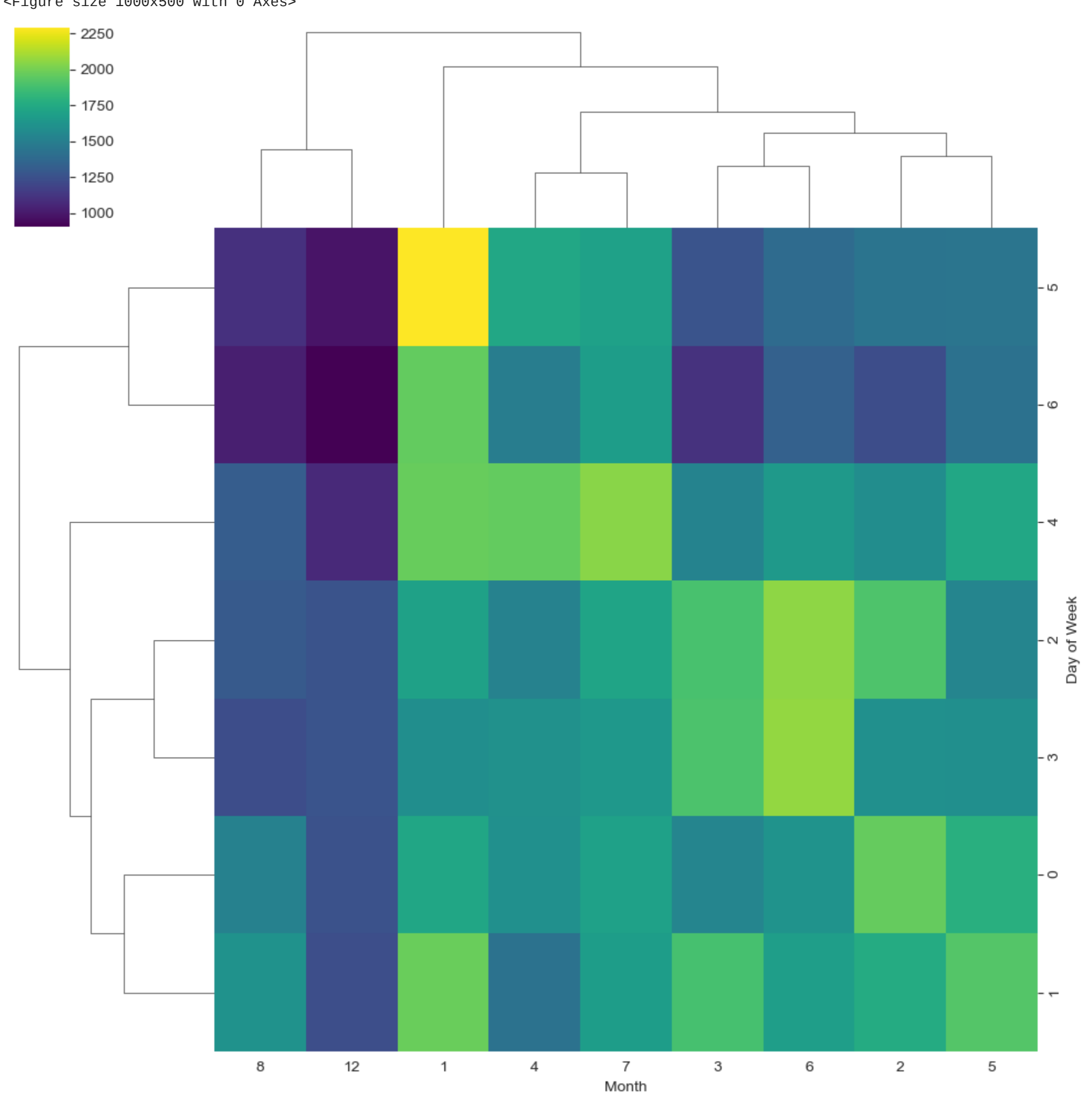
In [70]:
```
plt.figure(figsize=(10,5))
sns.heatmap(dayMonth,cmap='viridis')
```

Out[70]:
```
<Axes: xlabel='Month', ylabel='Day of Week'>
```

In [71]:
```
plt.figure(figsize=(10,5))
sns.clustermap(dayMonth,cmap='viridis')
```

Out[71]:
```
<seaborn.matrix.ClusterGrid at 0x275f1cb9180>
```

```
<Figure size 1000x500 with 0 Axes>
```



Thank You!