# citibike-2017NYC

October 29, 2020

[427]:
```
%matplotlib inline
import numpy as np
import pandas as pd
import plotly.graph_objs as go
from plotly import tools
import seaborn as sns
from plotly.offline import download_plotlyjs, init_notebook_mode, plot, iplot
init_notebook_mode(connected=True)
```

## 0.1 Imports

[428]:
```
df = pd.read_csv('/Users/jeffbloom13/WPI/DS504/week-7/201703-citibike-tripdata.csv')
weatherDf = pd.read_csv('/Users/jeffbloom13/WPI/DS504/week-7/NYCWeatherClean.csv')
```

[429]:
```
df.head(10)
```

[429]:

| | Trip Duration | Start Time | Stop Time | Start Station ID | Start Station Name | Start Station Latitude | Start Station Longitude |
|---|---|---|---|---|---|---|---|
| 0 | 1893 | 2017-03-01 00:00:32 | 2017-03-01 00:32:06 | 2009 | Catherine St & Monroe St | 40.711174 | -73.996826 |
| 1 | 223 | 2017-03-01 00:01:09 | 2017-03-01 00:04:53 | 127 | Barrow St & Hudson St | 40.731724 | -74.006744 |
| 2 | 1665 | 2017-03-01 00:01:27 | 2017-03-01 00:29:12 | 174 | E 25 St & 1 Ave | 40.738177 | -73.977387 |
| 3 | 100 | 2017-03-01 00:01:29 | 2017-03-01 00:03:10 | 316 | Fulton St & William St | 40.709560 | -74.006536 |
| 4 | 1229 | 2017-03-01 00:01:33 | 2017-03-01 00:22:02 | 536 | 1 Ave & E 30 St | 40.741444 | -73.975361 |
| 5 | 613 | 2017-03-01 00:01:57 | 2017-03-01 00:12:11 | 259 | South St & Whitehall St | 40.701221 | -74.012342 |
| 6 | 157 | 2017-03-01 00:02:12 | 2017-03-01 00:04:49 | 3329 | | | |
| 7 | 233 | 2017-03-01 00:02:15 | 2017-03-01 00:06:08 | 3107 | | | |
| 8 | 317 | 2017-03-01 00:02:38 | 2017-03-01 00:07:55 | 3328 | | | |
| 9 | 2042 | 2017-03-01 00:02:54 | 2017-03-01 00:36:57 | 128 | | | |

```
6      Degraw St & Smith St              40.682915              -73.993182
7  Bedford Ave & Nassau Ave              40.723117              -73.952123
8  W 100 St & Manhattan Ave              40.795000              -73.964500
9  MacDougal St & Prince St              40.727103              -74.002971

   End Station ID          End Station Name  End Station Latitude  \
0             527           E 33 St & 2 Ave             40.744023
1             284     Greenwich Ave & 8 Ave             40.739017
2             307     Canal St & Rutgers St             40.714275
3             306      Cliff St & Fulton St             40.708235
4             259   South St & Whitehall St             40.701221
5             276   Duane St & Greenwich St             40.717488
6            3384           Smith St & 3 St             40.678724
7            3090       N 8 St & Driggs Ave             40.717746
8            3285  W 87 St  & Amsterdam Ave             40.788390
9            3289   W 90 St & Amsterdam Ave             40.790179

   End Station Longitude  Bike ID   User Type  Birth Year  Gender
0             -73.976056    27291  Subscriber      1973.0       2
1             -74.002638    19387  Subscriber      1985.0       2
2             -73.989900    15809  Subscriber      1988.0       1
3             -74.005301    18956  Subscriber      1991.0       1
4             -74.012342    25728  Subscriber      1963.0       1
5             -74.010455    16257  Subscriber      1984.0       1
6             -73.995991    26868  Subscriber      1963.0       1
7             -73.956001    21657  Subscriber      1976.0       1
8             -73.974700    26933  Subscriber      1981.0       1
9             -73.972889    25371  Subscriber      1964.0       1
```

### 0.2 Clean data

[430]:
```
df.isna().sum()
```

[430]:
```
Trip Duration                0
Start Time                   0
Stop Time                    0
Start Station ID             0
Start Station Name           0
Start Station Latitude       0
Start Station Longitude      0
End Station ID               0
End Station Name             0
End Station Latitude         0
End Station Longitude        0
Bike ID                      0
User Type                 5136
Birth Year               32846
```

```
Gender                     0
dtype: int64
```

[431]:
```
df_wo_na = df.dropna()
```

[432]:
```
df['Birth Year'].apply(lambda y: y + 100 if y < 1918 else y)
df = df.reset_index(drop=True)
```

[433]:
```
from sklearn import neighbors
knn = neighbors.KNeighborsRegressor(10, weights='distance')
for col in ['Start Time', 'Stop Time']:
    df_wo_na[col] = df_wo_na[col].apply(lambda x: pd.Timestamp(x).value)
for col in ['Start Station Name', 'End Station Name', 'User Type']:
    df_wo_na[col] = pd.Categorical(df_wo_na[col]).codes
knn.fit(df_wo_na.drop(['Birth Year'], axis=1).values, df_wo_na['Birth Year'].
 ↪values)
```

[433]:
```
KNeighborsRegressor(algorithm='auto', leaf_size=30, metric='minkowski',
                    metric_params=None, n_jobs=None, n_neighbors=10, p=2,
                    weights='distance')
```

[434]:
```
nan_by = df[df['Birth Year'].isnull()]
for col in ['Start Time', 'Stop Time']:
    nan_by[col] = nan_by[col].apply(lambda x: pd.Timestamp(x).value)
for col in ['Start Station Name', 'End Station Name', 'User Type']:
    nan_by[col] = pd.Categorical(nan_by[col]).codes
nan_by = nan_by.drop(['Birth Year'], axis=1)
nan_by['Birth Year'] = knn.predict(nan_by)
df.loc[df['Birth Year'].isnull(), 'Birth Year'] = nan_by['Birth Year'].
 ↪astype(int)
df['age'] = df['Birth Year'].apply(lambda y: 2017 - y)
```

```
/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:3:
SettingWithCopyWarning:


A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy

/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:5:
SettingWithCopyWarning:


A value is trying to be set on a copy of a slice from a DataFrame.
```

```
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```

[435]:
```
df.isna().sum()
df = df.dropna()
df.isna().sum()
```

[435]:
```
Trip Duration              0
Start Time                 0
Stop Time                  0
Start Station ID           0
Start Station Name         0
Start Station Latitude     0
Start Station Longitude    0
End Station ID             0
End Station Name           0
End Station Latitude       0
End Station Longitude      0
Bike ID                    0
User Type                  0
Birth Year                 0
Gender                     0
age                        0
dtype: int64
```

[436]:
```
customer_type_df = pd.DataFrame(data=df['User Type'].value_counts())
customer_type_df = customer_type_df.reset_index()
customer_type_df.rename(columns={'User Type':'count', 'index': 'type'},␣
↪inplace=True)
```

[437]:
```
layout = go.Layout(
    title='User Type',
)
trace = go.Pie(labels=customer_type_df['type'].values,␣
↪values=customer_type_df['count'].values)
fig = go.Figure(data=[trace], layout=layout)
iplot(fig)
```

[438]:
```
y = list(range(0, 110, 10))
men_bins = []
women_bins = []
for i in range(0, len(y) - 1):
    df_gender = pd.DataFrame(data=df[( df['age'] >  y[i] ) & (df['age'] <␣
↪y[i+1]) ]['Gender'].value_counts())
```

```
    df_gender = df_gender.reset_index()
    df_gender.rename(columns={'Gender':'count', 'index':'gender'}, inplace=True)
    count = df_gender[df_gender['gender'] == 1]['count']
    men_bins.append(0 if len(count) == 0 else count.values[0])
    count2 = df_gender[df_gender['gender'] == 2]['count']
    women_bins.append(0 if len(count2) == 0 else -count2.values[0])

layout = go.Layout(yaxis=go.layout.YAxis(title='Age'),
                   title="Gender",
                    barmode='overlay',
                    bargap=0.1)

data = [
        go.Bar(y=y,
               x=women_bins,
               orientation='h',
               name='Women',
               text=-1 * women_bins,
               hoverinfo='text',
               marker=dict(color='purple')
               ),go.Bar(y=y,
               x=men_bins,
               orientation='h',
               name='Men',
               hoverinfo='x',
               marker=dict(color='plum')
               )]
iplot(dict(data=data, layout=layout))
```

[439]:
```
df['Start Time'] = df['Start Time'].apply(pd.to_datetime)
def extract_part_of_day(hour):
    if hour < 4:
        return 'early morning'
    if hour < 10:
        return 'morning'
    if hour < 14:
        return 'noon'
    if hour < 18:
        return 'afternoon'
    return 'evening'
df['part_of_day'] = df['Start Time'].apply(lambda t: extract_part_of_day(t.
 ↪hour))
```

[440]:
```
df_station_end = df.groupby(['End Station ID', 'End Station Name', 'End Station␣
 ↪Latitude', 'End Station Longitude']).count().reset_index()[['End Station␣
 ↪ID', 'End Station Name', 'End Station Latitude', 'End Station Longitude',␣
 ↪'age']]
```

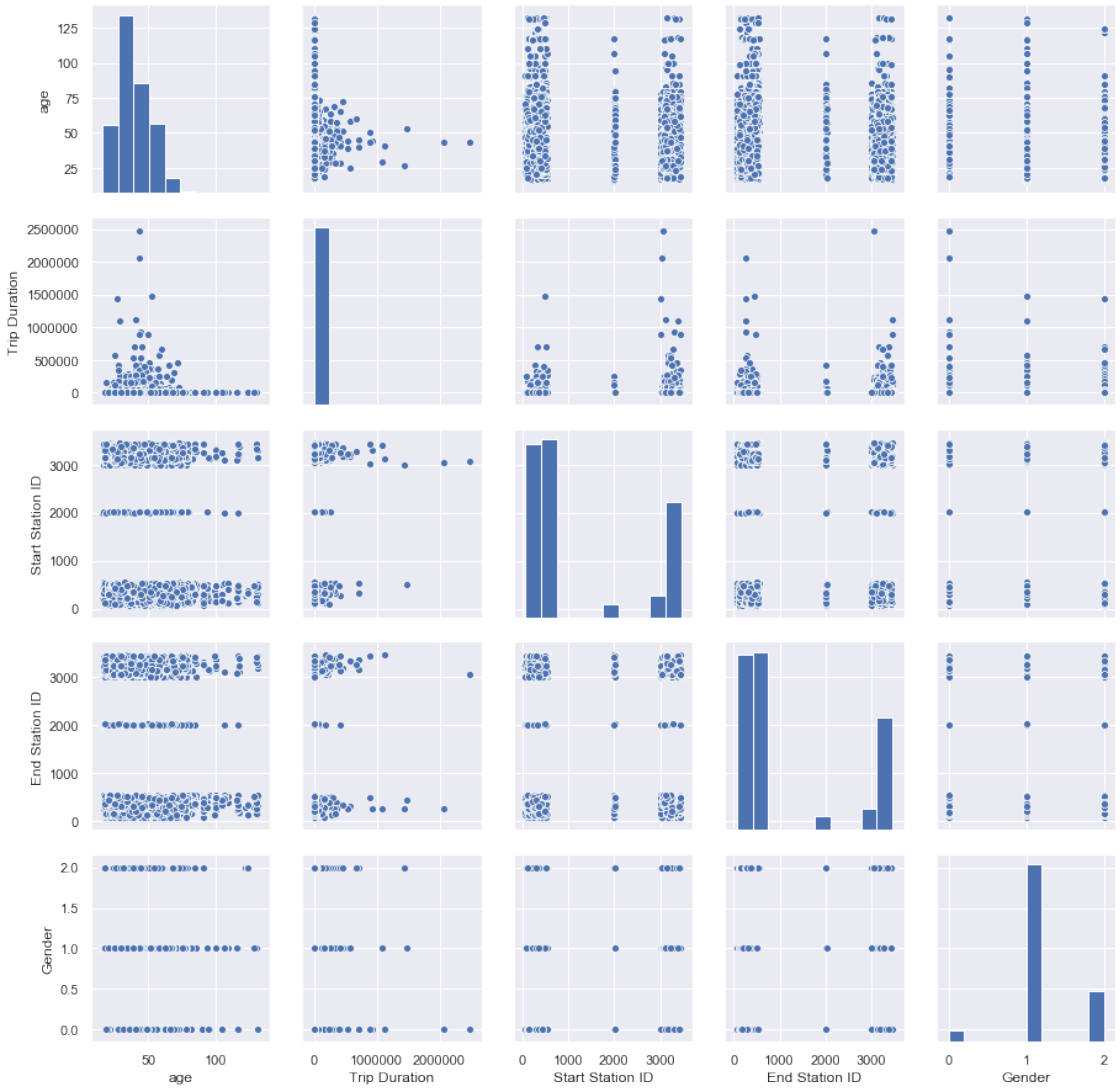
```
df_station_end.rename(columns={
    'End Station ID': 'id',
    'End Station Name': 'name',
    'End Station Latitude':'lat',
    'End Station Longitude': 'lon'
}, inplace= True)
df_station_start = df.groupby(['Start Station ID', 'Start Station Name', 'Start␣
 ↪Station Latitude', 'Start Station Longitude']).count().reset_index()[['Start␣
 ↪Station ID', 'Start Station Name', 'Start Station Latitude', 'Start Station␣
 ↪Longitude', 'age']]
df_station_start.rename(columns={
    'Start Station ID': 'id',
    'Start Station Name': 'name',
    'Start Station Latitude':'lat',
    'Start Station Longitude': 'lon'
}, inplace= True)

df_paths = df.groupby(['End Station ID', 'End Station Name', 'End Station␣
 ↪Latitude', 'End Station Longitude','Start Station ID', 'Start Station Name',␣
 ↪'Start Station Latitude', 'Start Station Longitude']).count().reset_index()
```

[441]:
```
mapbox_access_token = 'pk.
 ↪eyJ1Ijoiam1ibG9vbSIsImEiOiJja2Y1cm1maHUwYjNnMnBxN3pqcGZqNjd4In0.
 ↪7r3hp8Vj1efich43hkUaDQ'


data = []
data.append(go.Scattermapbox(
        lat=df_station_start['lat'].values,
        lon=df_station_start['lon'].values,
        mode='markers',
        marker=dict(
                size=9
        ),
         text=df_station_start['name'].values
    ))
for i in range(len(df_paths)//2 - 1, len(df_paths)//2-100, -1):
     data.append(go.Scattermapbox(
        lat=[df_paths['Start Station Latitude'][i], df_paths['End Station␣
 ↪Latitude'][i]],
        lon=[ df_paths['Start Station Longitude'][i], df_paths['End Station␣
 ↪Longitude'][i]],
        mode='lines',
        line = dict(
                width = 1,
                color = 'red',
            ),
```

```
    ))
layout = go.Layout(
    autosize=True,
    hovermode='closest',
    mapbox=dict(
        accesstoken=mapbox_access_token,
        bearing=0,
        center=dict(
            lat=40.76,
            lon=-73.99
        ),
        pitch=0,
        zoom=12
    ),
    showlegend = False
)


fig = dict(data=data, layout=layout)
iplot(fig, filename='Multiple Mapbox')
```

[442]:
```
sns.pairplot(df[['age','Trip Duration', 'Start Station ID', 'End Station␣
↪ID','Gender']])
```

[442]: <seaborn.axisgrid.PairGrid at 0x7fcae0210550>




[443]:
```
df.head(5)
```

[443]:

| | Trip Duration | Start Time | Stop Time | Start Station ID |
|---|---|---|---|---|
| 0 | 1893 | 2017-03-01 00:00:32 | 2017-03-01 00:32:06 | 2009 |
| 1 | 223 | 2017-03-01 00:01:09 | 2017-03-01 00:04:53 | 127 |
| 2 | 1665 | 2017-03-01 00:01:27 | 2017-03-01 00:29:12 | 174 |
| 3 | 100 | 2017-03-01 00:01:29 | 2017-03-01 00:03:10 | 316 |
| 4 | 1229 | 2017-03-01 00:01:33 | 2017-03-01 00:22:02 | 536 |

| | Start Station Name | Start Station Latitude | Start Station Longitude |
|---|---|---|---|
| 0 | Catherine St & Monroe St | 40.711174 | -73.996826 |
| 1 | Barrow St & Hudson St | 40.731724 | -74.006744 |
| 2 | E 25 St & 1 Ave | 40.738177 | -73.977387 |
| 3 | Fulton St & William St | 40.709560 | -74.006536 |

```
4           1 Ave & E 30 St               40.741444               -73.975361

   End Station ID         End Station Name  End Station Latitude  \
0             527          E 33 St & 2 Ave             40.744023
1             284    Greenwich Ave & 8 Ave             40.739017
2             307    Canal St & Rutgers St             40.714275
3             306     Cliff St & Fulton St             40.708235
4             259  South St & Whitehall St             40.701221

   End Station Longitude  Bike ID   User Type  Birth Year  Gender   age  \
0             -73.976056    27291  Subscriber      1973.0       2  44.0
1             -74.002638    19387  Subscriber      1985.0       2  32.0
2             -73.989900    15809  Subscriber      1988.0       1  29.0
3             -74.005301    18956  Subscriber      1991.0       1  26.0
4             -74.012342    25728  Subscriber      1963.0       1  54.0

     part_of_day
0  early morning
1  early morning
2  early morning
3  early morning
4  early morning
```

[444]:
```
day_parts = ['early morning','morning', 'noon', 'afternoon','evening']
fig = tools.make_subplots(rows=1, cols=5, subplot_titles=day_parts)

df_station_end = df.groupby(['End Station ID', 'End Station Name', 'End Station␣
↪Latitude', 'End Station Longitude','part_of_day']).count().
↪reset_index()[['End Station ID', 'End Station Name', 'End Station Latitude',␣
↪'End Station Longitude', 'age','part_of_day']]
df_station_end.rename(columns={
    'End Station ID': 'id',
    'End Station Name': 'name',
    'End Station Latitude':'lat',
    'End Station Longitude': 'lon'
}, inplace= True)
df_station_start = df.groupby(['Start Station ID', 'Start Station Name', 'Start␣
↪Station Latitude', 'Start Station Longitude','part_of_day']).count().
↪reset_index()[['Start Station ID', 'Start Station Name', 'Start Station␣
↪Latitude', 'Start Station Longitude', 'age','part_of_day']]
df_station_start.rename(columns={
    'Start Station ID': 'id',
    'Start Station Name': 'name',
    'Start Station Latitude':'lat',
    'Start Station Longitude': 'lon'
}, inplace= True)
```

```
for idx, daypart in enumerate(day_parts):
    df_start_top10 = df_station_start[df_station_start['part_of_day'] ==␣
 ↪daypart].sort_values(['age'], ascending=False).head(10)
    trace = go.Bar(
            x=df_start_top10.name,
            y=df_start_top10.age
    )
    fig.append_trace(trace, 1, idx + 1)

fig['layout'].update(title='Top 10 start station')

iplot(fig)
```

```
/opt/anaconda3/lib/python3.7/site-packages/plotly/tools.py:465:
DeprecationWarning:

plotly.tools.make_subplots is deprecated, please use
plotly.subplots.make_subplots instead
```

[445]:
```
fig2 = tools.make_subplots(rows=1, cols=5, subplot_titles=day_parts)
for idx, daypart in enumerate(day_parts):
    df_start_top10 = df_station_end[df_station_end['part_of_day'] == daypart].
 ↪sort_values(['age'], ascending=False).head(10)
    trace = go.Bar(
            x=df_start_top10.name,
            y=df_start_top10.age
    )
    fig2.append_trace(trace, 1, idx + 1)

fig2['layout'].update(title='Top 5 end station')

iplot(fig2)
```

[446]:
```
#df.index = df['Start Time']
#countsPerDay = df['Start Time'].resample('D', how = ['count'])

df.index = df['Start Time'] # Set 'starttime' variable as the index
#countsPerDay = df['Start Time'].resample('D', how = ['count'])
countsPerDay = df['Start Time'].resample('D').count()
```

[447]:
```
countsPerDay.values
#countsPerDay.head()
```

[447]:
```
array([40401, 35517, 30927, 15498, 15760, 32344, 29574, 43172, 44866,
       18351, 15060, 13357, 27303,     0,     0,     0,  7029,  4073,
```

```
       10397, 27269, 36611, 26806, 29716, 33824, 28948, 19603, 26166,
       21493, 42157, 39375,  6932])
```

[448]:
```
ndim = countsPerDay.shape[0]
ndim
```

[448]:
```
31
```

[449]:
```
# Now add count
weatherDf['count'] = 0
ndim = countsPerDay.shape[0]
for index,row in weatherDf.iterrows():
    #print('colNum=', i)
    #print('val=', df2.iloc[: , idx].values)
    #print('day=',j['Day'])

    print(row['Day'], row['P'])
    #row['count'] = countsPerDay['count'].values[index]
    if index < ndim:
        print('count=', countsPerDay.values[index])
       # df['count'][index] = countsPerDay['count'].values[index]
        weatherDf.loc[index,'count'] = countsPerDay.values[index]
```

```
1.0 0.0
count= 40401
2.0 0.12
count= 35517
3.0 0.0
count= 30927
4.0 0.0
count= 15498
5.0 0.0
count= 15760
6.0 0.0
count= 32344
7.0 0.0
count= 29574
8.0 0.16
count= 43172
9.0 0.0
count= 44866
10.0 0.0
count= 18351
11.0 0.24
count= 15060
12.0 0.0
count= 13357
```

```
13.0 0.0
count= 27303
14.0 0.32
count= 0
15.0 0.71
count= 0
16.0 0.0
count= 0
17.0 0.0
count= 7029
18.0 0.0
count= 4073
19.0 0.07
count= 10397
20.0 0.0
count= 27269
21.0 0.0
count= 36611
22.0 0.0
count= 26806
23.0 0.0
count= 29716
24.0 0.0
count= 33824
25.0 0.0
count= 28948
26.0 0.1
count= 19603
27.0 0.02
count= 26166
28.0 0.42
count= 21493
29.0 0.43
count= 42157
30.0 0.0
count= 39375
31.0 0.33
count= 6932
```

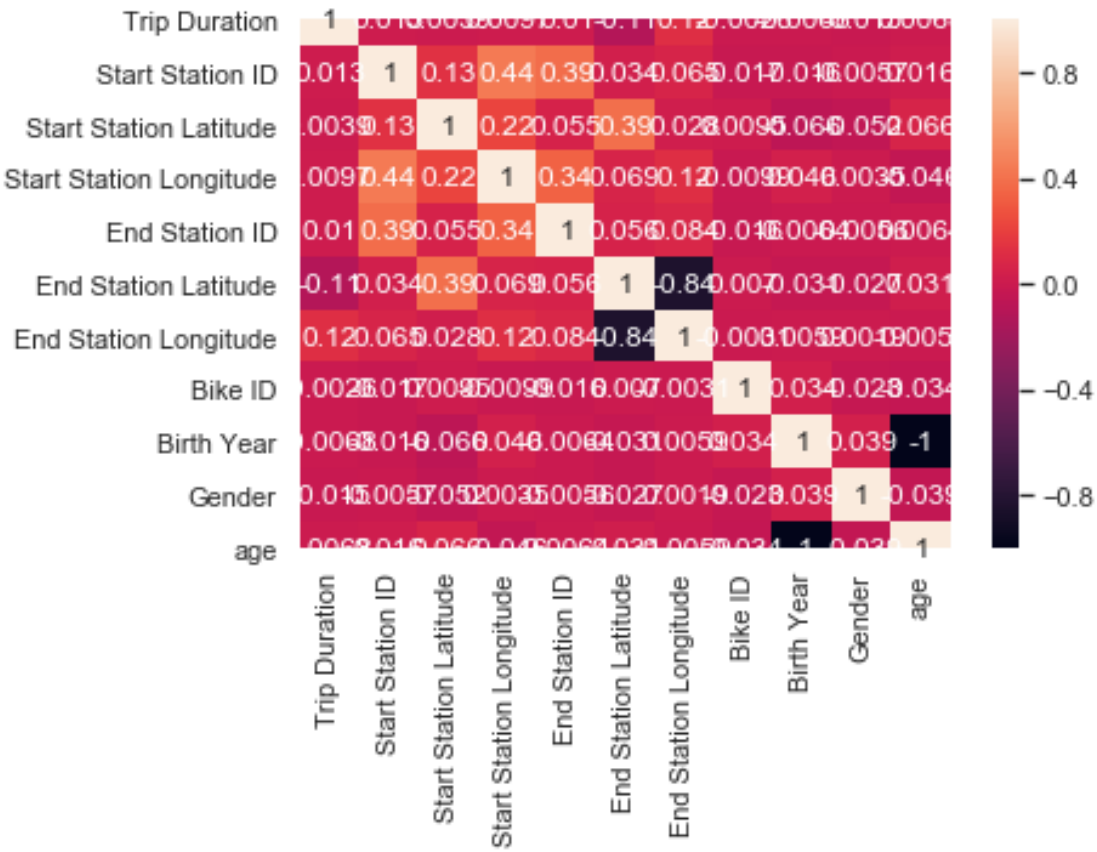
[450]:
```
weatherDf
```

[450]:

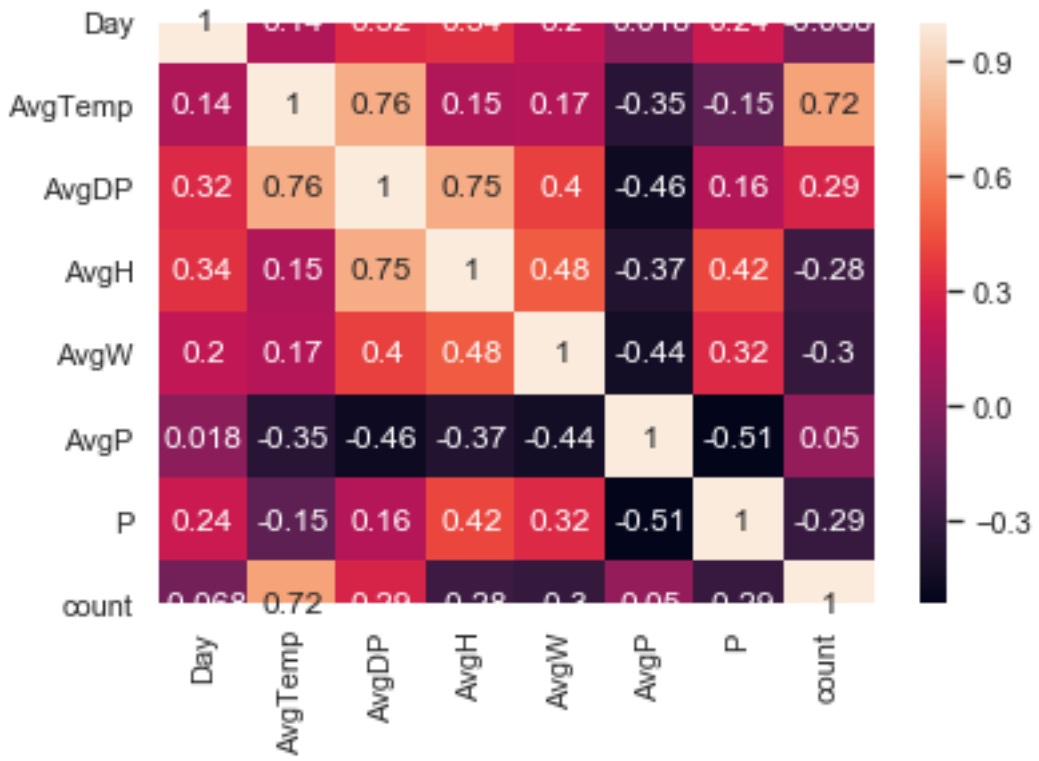
| | Day | AvgTemp | AvgDP | AvgH | AvgW | AvgP | P | count |
|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 59.2 | 53.1 | 81.3 | 8.0 | 29.7 | 0.00 | 40401 |
| 1 | 2 | 48.0 | 23.3 | 38.7 | 10.7 | 29.8 | 0.12 | 35517 |
| 2 | 3 | 34.9 | 12.8 | 41.1 | 6.4 | 30.3 | 0.00 | 30927 |
| 3 | 4 | 26.7 | 6.2 | 42.8 | 5.5 | 30.5 | 0.00 | 15498 |
| 4 | 5 | 28.6 | 1.2 | 33.3 | 4.3 | 30.6 | 0.00 | 15760 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5 | 6 | 36.9 | 17.7 | 47.0 | 5.3 | 30.5 | 0.00 | 32344 |
| 6 | 7 | 47.5 | 41.7 | 80.5 | 4.3 | 30.2 | 0.00 | 29574 |
| 7 | 8 | 54.7 | 34.0 | 49.6 | 11.5 | 29.9 | 0.16 | 43172 |
| 8 | 9 | 55.2 | 22.6 | 29.2 | 10.2 | 29.9 | 0.00 | 44866 |
| 9 | 10 | 37.4 | 25.8 | 66.1 | 7.6 | 29.9 | 0.00 | 18351 |
| 10 | 11 | 26.2 | 9.7 | 50.0 | 5.8 | 30.2 | 0.24 | 15060 |
| 11 | 12 | 27.7 | 9.4 | 46.7 | 4.9 | 30.3 | 0.00 | 13357 |
| 12 | 13 | 30.1 | 11.8 | 48.3 | 6.2 | 30.4 | 0.00 | 27303 |
| 13 | 14 | 30.8 | 27.5 | 88.1 | 14.1 | 29.6 | 0.32 | 0 |
| 14 | 15 | 25.9 | 15.7 | 65.3 | 8.3 | 29.6 | 0.71 | 0 |
| 15 | 16 | 33.3 | 15.0 | 49.3 | 8.7 | 30.0 | 0.00 | 0 |
| 16 | 17 | 38.1 | 19.1 | 47.5 | 8.1 | 30.2 | 0.00 | 7029 |
| 17 | 18 | 36.8 | 27.7 | 70.9 | 12.2 | 30.2 | 0.00 | 4073 |
| 18 | 19 | 41.9 | 24.3 | 52.2 | 9.8 | 30.2 | 0.07 | 10397 |
| 19 | 20 | 44.4 | 19.1 | 38.2 | 5.2 | 30.1 | 0.00 | 27269 |
| 20 | 21 | 50.4 | 29.0 | 44.5 | 5.6 | 29.9 | 0.00 | 36611 |
| 21 | 22 | 38.4 | 12.2 | 34.7 | 4.8 | 30.1 | 0.00 | 26806 |
| 22 | 23 | 35.0 | 9.2 | 37.9 | 6.4 | 30.5 | 0.00 | 29716 |
| 23 | 24 | 44.8 | 28.6 | 53.9 | 9.0 | 30.3 | 0.00 | 33824 |
| 24 | 25 | 50.7 | 38.3 | 63.4 | 7.8 | 30.2 | 0.00 | 28948 |
| 25 | 26 | 41.1 | 35.3 | 79.8 | 12.9 | 30.4 | 0.10 | 19603 |
| 26 | 27 | 44.7 | 41.8 | 89.7 | 7.0 | 30.1 | 0.02 | 26166 |
| 27 | 28 | 44.4 | 42.5 | 93.1 | 9.9 | 29.9 | 0.42 | 21493 |
| 28 | 29 | 50.3 | 34.9 | 60.1 | 4.7 | 30.1 | 0.43 | 42157 |
| 29 | 30 | 44.5 | 27.0 | 51.0 | 6.9 | 30.2 | 0.00 | 39375 |
| 30 | 31 | 40.4 | 37.8 | 91.0 | 14.9 | 30.0 | 0.33 | 6932 |

[451]:
```
import matplotlib.pyplot as plt

sns.set(font_scale=1)
sns.heatmap(df.corr(), annot=True)
plt.show()
```




[452]:
```
sns.set(font_scale=1)

sns.heatmap(weatherDf.corr(), annot=True)
plt.show()
```




[453]:
```
# Now let's setup a test and train for the month of March 2017
from sklearn.model_selection import train_test_split
#X_train, X_test, y_train, y_test = train_test_split(weatherDf.drop(columns =␣
↪['count'], axis=1), weatherDf['count'], test_size=0.3)

#X = np.array(weatherDf.drop(weatherDf[['Day', 'count']], 1))
y = np.array(weatherDf['count'])

X = np.array(weatherDf.drop(weatherDf[['Day']], 1))


X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2)
```

[454]:
```
def rmsle(y, y_):
    log1 = np.nan_to_num(np.array([np.log(v + 1) for v in y]))
    log2 = np.nan_to_num(np.array([np.log(v + 1) for v in y_]))
    calc = (log1 - log2) ** 2
    return np.sqrt(np.mean(calc))
```

[455]:
```
from sklearn.linear_model import LinearRegression
clfL = LinearRegression(normalize= True)
clfL.fit(X_train, y_train)
```

```
print("Linear regression accuracy => ", clfL.score(X_test, y_test), "\nRMSLE =>␣
 ↪", rmsle(y_test, clfL.predict(X_test)))
```

```
Linear regression accuracy =>  1.0
RMSLE =>  0.0
```

[456]:
```
from sklearn.tree import DecisionTreeRegressor

clfD = DecisionTreeRegressor()
clfD.fit(X_train, y_train)
print("Decision Tree accuracy => ", clfD.score(X_test, y_test), "\nRMSLE => ",␣
 ↪rmsle(y_test, clfD.predict(X_test)))
```

```
Decision Tree accuracy =>  0.9017284305425849
RMSLE =>  0.22299965006031033
```

[457]:
```
from sklearn.ensemble import RandomForestRegressor

clf = RandomForestRegressor(n_estimators=200, max_depth=4, oob_score=True)
clf.fit(X_train, y_train)
print('Random Forest accuracy => ', clf.score(X_test, y_test), "\nRMSLE => ",␣
 ↪rmsle(y_test, clf.predict(X_test)))
```

```
Random Forest accuracy =>  0.9386498004096957
RMSLE =>  0.12311994271624266
```

[458]:
```
clf.feature_importances_
```

[458]:
```
array([0.10754741, 0.01116078, 0.01172885, 0.01419438, 0.00865591,
       0.00866509, 0.83804758])
```

[459]:
```
weatherDf.columns
```

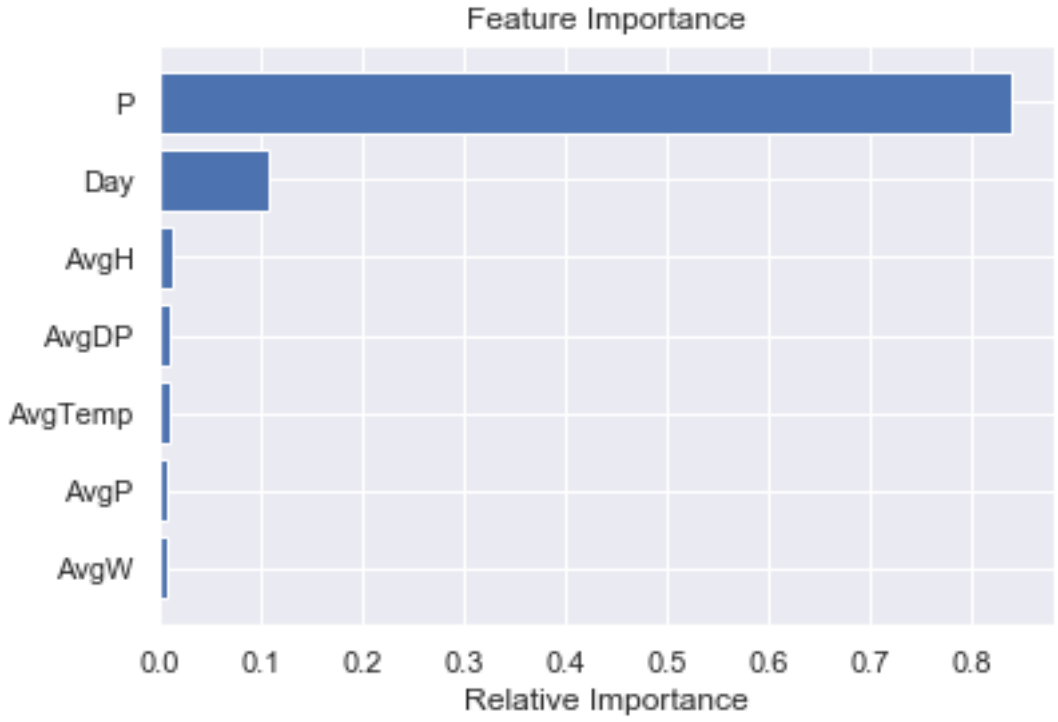
[459]:
```
Index(['Day', 'AvgTemp', 'AvgDP', 'AvgH', 'AvgW', 'AvgP', 'P', 'count'],
dtype='object')
```

[460]:
```
dfTest = weatherDf
dfTest.drop(['count'], axis=1, inplace=True)
dfTest.columns
```

[460]:
```
Index(['Day', 'AvgTemp', 'AvgDP', 'AvgH', 'AvgW', 'AvgP', 'P'], dtype='object')
```

[461]:
```
importances = clf.feature_importances_
indices = np.argsort(importances)
features = dfTest.columns
```

[462]:
```
plt.title('Feature Importance')
#plt.barh(dfTest.columns, clf.feature_importances_.argsort())
plt.barh(range(len(indices)), importances[indices])

plt.yticks(range(len(indices)), [features[i] for i in indices])
plt.xlabel('Relative Importance')
plt.show()
```




[463]:
```
pred_test = clf.predict(X_test)
pred_train = clf.predict(X_train)
```

[464]:
```
from sklearn.metrics import r2_score
from scipy.stats import spearmanr, pearsonr
test_score = r2_score(y_test, pred_test)
spearman = spearmanr(y_test, pred_test)
pearson = pearsonr(y_test, pred_test)
```

[465]:
```
print(f'Out of bag R-2 score estimate: {clf.oob_score_:>5.3}')
print(f'Test data R-2 score:  {test_score:>5.3}')
print(f'Test data Spearman correlation: {spearman[0]:.3}')
print(f'Test data Pearson correlation: {pearson[0]:.3}')
```

```
Out of bag R-2 score estimate: 0.958
Test data R-2 score:  0.939
```

```
Test data Spearman correlation: 1.0
Test data Pearson correlation: 0.99
```

[466]:
```
clf
```

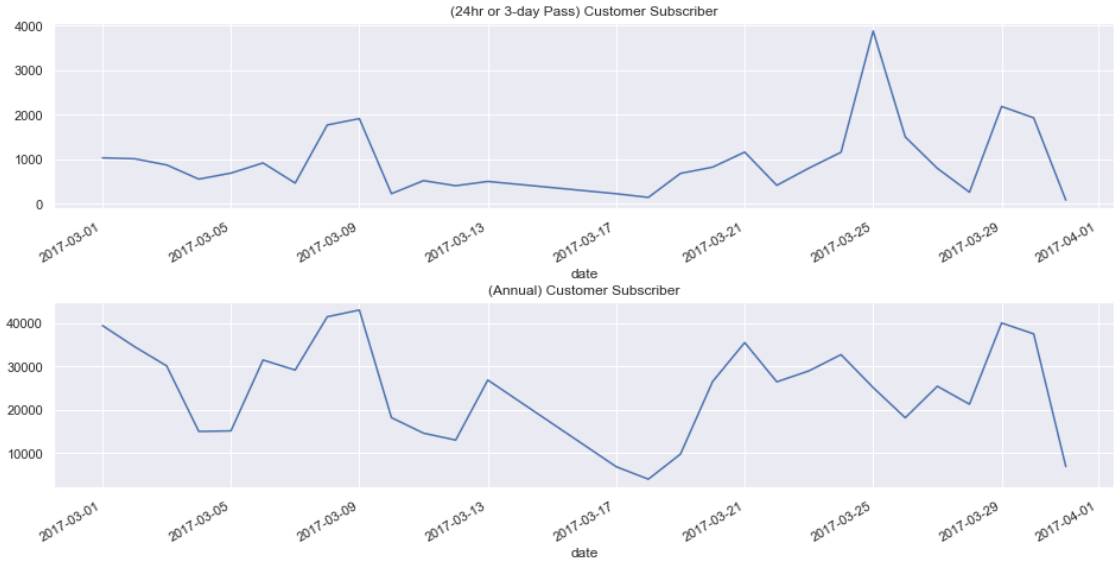
[466]:
```
RandomForestRegressor(bootstrap=True, criterion='mse', max_depth=4,
                      max_features='auto', max_leaf_nodes=None,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=2,
                      min_weight_fraction_leaf=0.0, n_estimators=200,
                      n_jobs=None, oob_score=True, random_state=None, verbose=0,
                      warm_start=False)
```

[467]:
```
#df[['count', 'workingday']].groupby(['workingday'], as_index = False).mean().
 ↪sort_values(by = 'count')
#df[['Start Station Name','Start Time']].groupby(['Start Station Name']),␣
 ↪as_index = False).sum().sort_values(by = 'Start Station Name')
```

[468]:
```
ind = pd.DatetimeIndex(df['Start Time'])
df['date'] = ind.date.astype('datetime64')
df['hour'] = ind.hour
```

[469]:
```
#df['Start Time'].count()
by_date = df.pivot_table('Start Station ID', aggfunc='count',
                         index='date',
                         columns='User Type',)
```

[470]:
```
fig, ax = plt.subplots(2, figsize=(16,8))
fig.subplots_adjust(hspace=0.5)
by_date.iloc[:,0].plot(ax=ax[0], title='(24hr or 3-day Pass) Customer␣
 ↪Subscriber');
by_date.iloc[:,1].plot(ax=ax[1], title='(Annual) Customer Subscriber');
```




[471]:
```
by_date.head()
#df.head()
```

[471]:
```
User Type   Customer  Subscriber
date
2017-03-01      1027       39374
2017-03-02      1006       34511
2017-03-03       867       30060
2017-03-04       549       14949
2017-03-05       684       15076
```

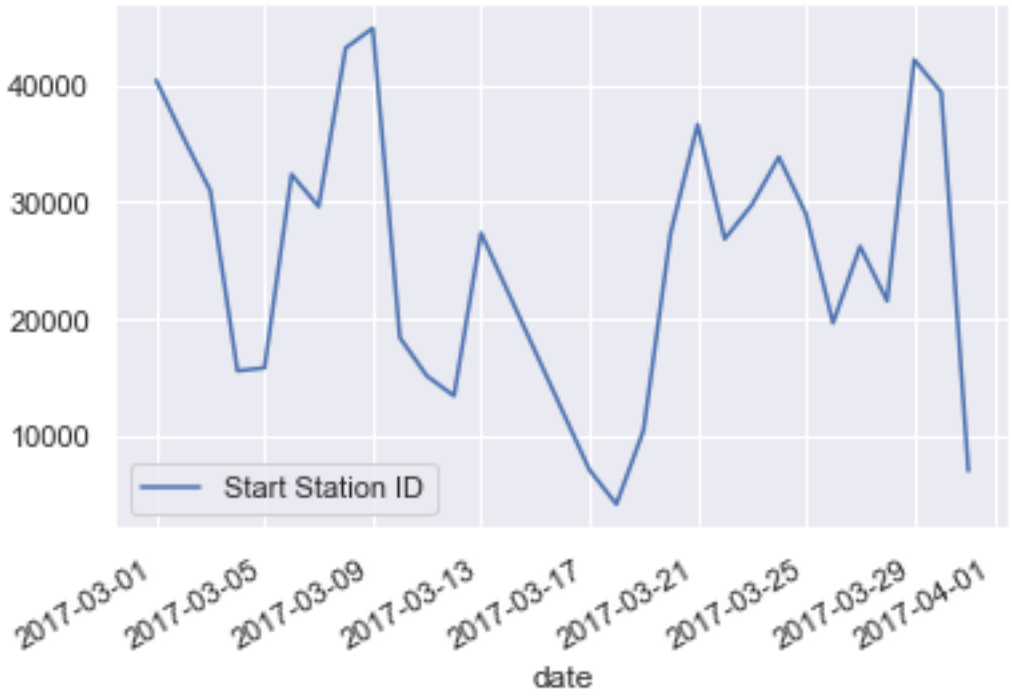
[472]:
```
count_by_date = df.pivot_table('Start Station ID', aggfunc='count',
                               index='date',)
```

[473]:
```
#count_by_date.head()
#count_by_date.describe
count_by_date.style
```

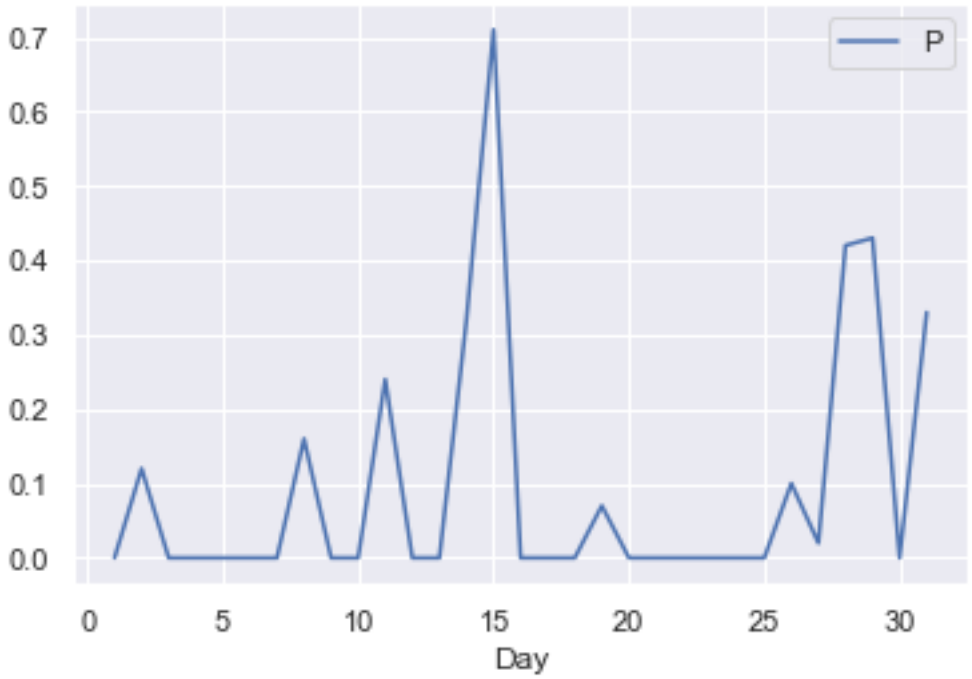
[473]:
```
<pandas.io.formats.style.Styler at 0x7fca4eee5d90>
```

[474]:
```
count_by_date.plot()
```

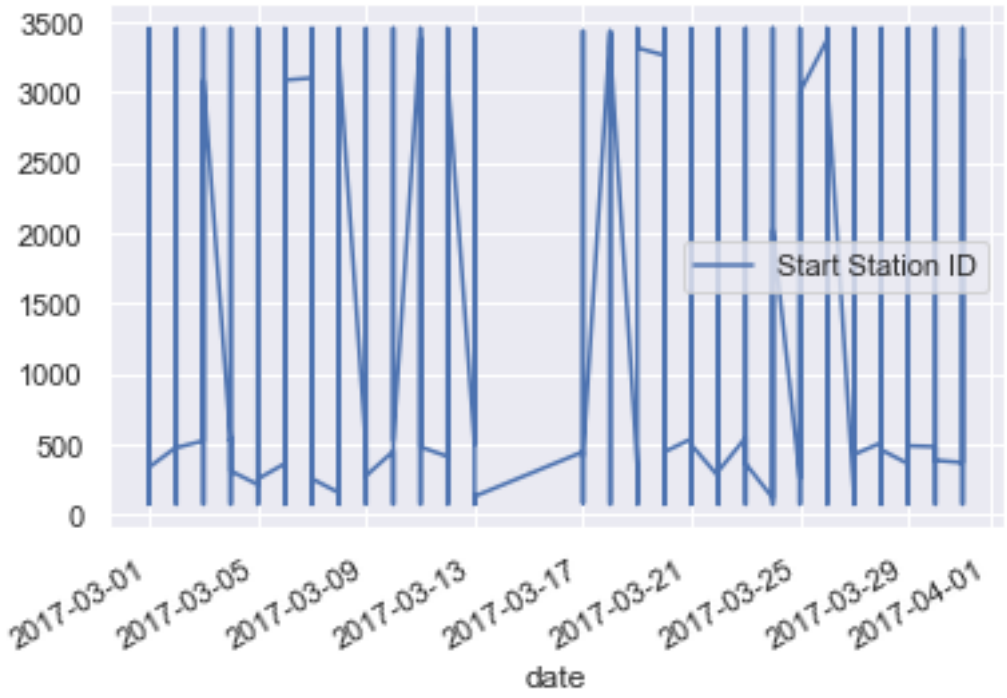
[474]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fca4eec1350>
```




[475]:
```
# now print weatherdf
import matplotlib.pyplot as plt
ax = plt.gca()

weatherDf.plot(kind='line',x='Day',y='P',ax=ax)
plt.show()
```




[476]:
```
ax = plt.gca()

df.plot(kind='line',x='date',y='Start Station ID',ax=ax)
#df.plot(kind='line',x='Day',y='AvgDP', color='red', ax=ax)

plt.show()
```




[477]:
```
group_by_start_station = (df.groupby(['Start Station ID'])
                     .apply(lambda x: (x['Start Station ID']==519).count())
                     .reset_index(name='count'))
```

[478]:
```
#group_by_start_station['Start Station ID']==519
print(group_by_start_station)
```

```
     Start Station ID  count
0                  72   1887
1                  79   1256
2                  82    547
3                  83    567
4                 116   2216
..                 …     …
609              3452    263
610              3453    324
611              3454    257
612              3455    157
613              3456     26

[614 rows x 2 columns]
```

[479]:
```
print(group_by_start_station['Start Station ID'].values[519])
```

```
3348
```

[480]:
```
print(group_by_start_station.nlargest(5, 'count'))
```

```
     Start Station ID  count
269               519   9040
250               497   5429
194               435   5276
245               492   5265
168               402   5152
```

[481]:
```
#count_by_date2 = df.pivot_table(index=['Start Station Name','Start Station␣
 ↪ID'],aggfunc=np.sum,values=['mycount'])

#countdate2 = df.pivot_table(df.loc[df['Start Station ID']=='519'],␣
 ↪index='date', aggfunc='count')

countsdate2 = df['Start Station ID'].value_counts(normalize=True)

#count_by_date = df.pivot_table('Start Station ID', aggfunc='count',
#                               index='date',)
```

[482]:
```
countdate2 = df
countdate2.head()
#countdate2 == 519
#countsdate2 = df.groupby('Start Station ID').filter(lambda x: x.
 ↪values[519]==519)


#count_by_date2 = countdate2.eq('Start Station ID' == 519).pivot_table('Start␣
 ↪Station ID', aggfunc='count',
#                               index='date',)

df6 = countdate2.loc['2017-03-08']
```

[483]:
```
#df6['Start Station ID']==519
df6.shape
```

[483]: (43172, 19)

[484]:
```
onecountNoRain=0
for index, row in df6.iterrows():
    if row['Start Station ID'] == 519:  # Pershing Square North
        #print(row['Start Time'], row['Start Station Name'])
        onecountNoRain = onecountNoRain + 1
```

[485]:
```
onecountNoRain
```

[485]: 542

[486]:
```
df6 = countdate2.loc['2017-03-17']

onecountRain=0
for index, row in df6.iterrows():
    if row['Start Station ID'] == 519:  # Pershing Square North
        #print(row['Start Time'], row['Start Station Name'])
        onecountRain = onecountRain + 1
```

[487]:
```
onecountRain
```

[487]: 129

[ ]:
```

```