4

February 24, 2020

1 Instructions

The following Cells need to be executed.

They are used to download and generate a dataset that has an aggregated count of bike trips per hundredth of an hour through the 24 hours in a day.

The assignment is in the last cell.

1.1 This cell automatically downloads Capital Bikeshare data

1.1.1 And here we read in the data

```
[1]: import seaborn as sns
     import matplotlib.pyplot as plt
     %matplotlib inline
     plt.rcParams['figure.figsize'] = 20, 10
     import pandas as pd
     import numpy as np
     bikes = pd.read_csv('../data/bikeshare.csv.gz')
     bikes.head()
     bikes['start'] = pd.to_datetime(bikes['Start date'], infer_datetime_format=True)
     bikes['end'] = pd.to_datetime(bikes['End date'], infer_datetime_format=True)
     bikes["dur"] = (bikes['Duration (ms)']/1000).astype(int)
     bikes.head()
```

```
[1]:    Duration (ms)       Start date          End date  Start station number  \
     0         301295  3/31/2016 23:59    4/1/2016 0:04                 31280
     1         557887  3/31/2016 23:59    4/1/2016 0:08                 31275
     2         555944  3/31/2016 23:59    4/1/2016 0:08                 31101
     3         766916  3/31/2016 23:57    4/1/2016 0:09                 31226
     4         139656  3/31/2016 23:57  3/31/2016 23:59                 31011

                         Start station  End station number  \
     0                 11th & S St NW               31506
     1  New Hampshire Ave & 24th St NW               31114
     2                 14th & V St NW               31221
     3      34th St & Wisconsin Ave NW               31214
     4                23rd & Crystal Dr               31009
```

```
                 End station Bike number Member Type               start  \
0  1st & Rhode Island Ave NW      W00022  Registered 2016-03-31 23:59:00
1   18th St & Wyoming Ave NW      W01294  Registered 2016-03-31 23:59:00
2             18th & M St NW      W01416  Registered 2016-03-31 23:59:00
3      17th & Corcoran St NW      W01090  Registered 2016-03-31 23:57:00
4          27th & Crystal Dr      W21934  Registered 2016-03-31 23:57:00

                  end  dur
0 2016-04-01 00:04:00  301
1 2016-04-01 00:08:00  557
2 2016-04-01 00:08:00  555
3 2016-04-01 00:09:00  766
4 2016-03-31 23:59:00  139
```

```
[2]: bikes.dur.mean()
```

```
[2]: 992.8716543657755
```

```
[3]: bikes.dur.std()
```

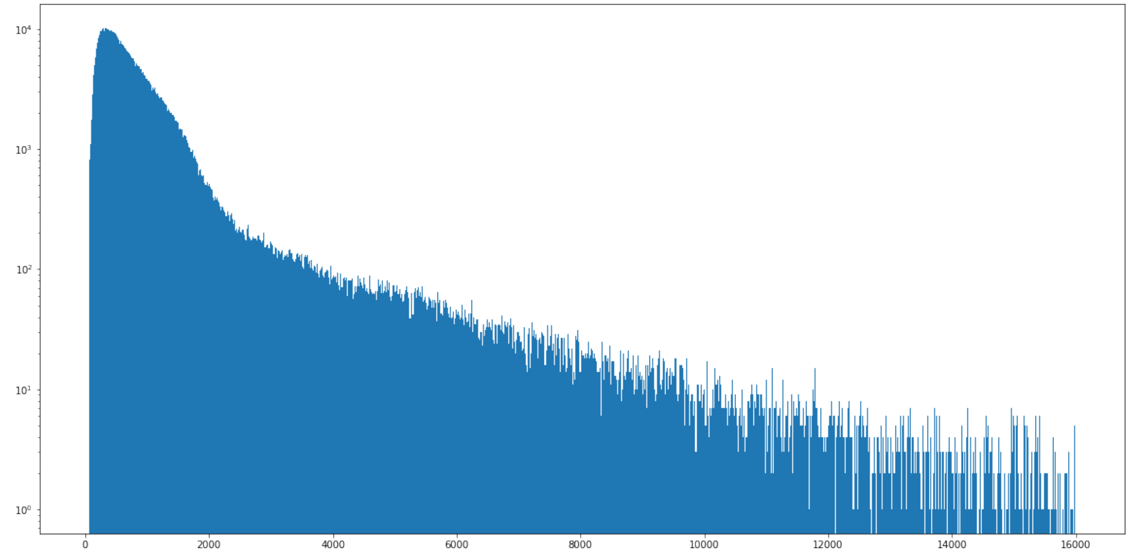
```
[3]: 2073.9809135296764
```

```
[4]: bikes[bikes.dur>16000].shape
```

```
[4]: (973, 12)
```

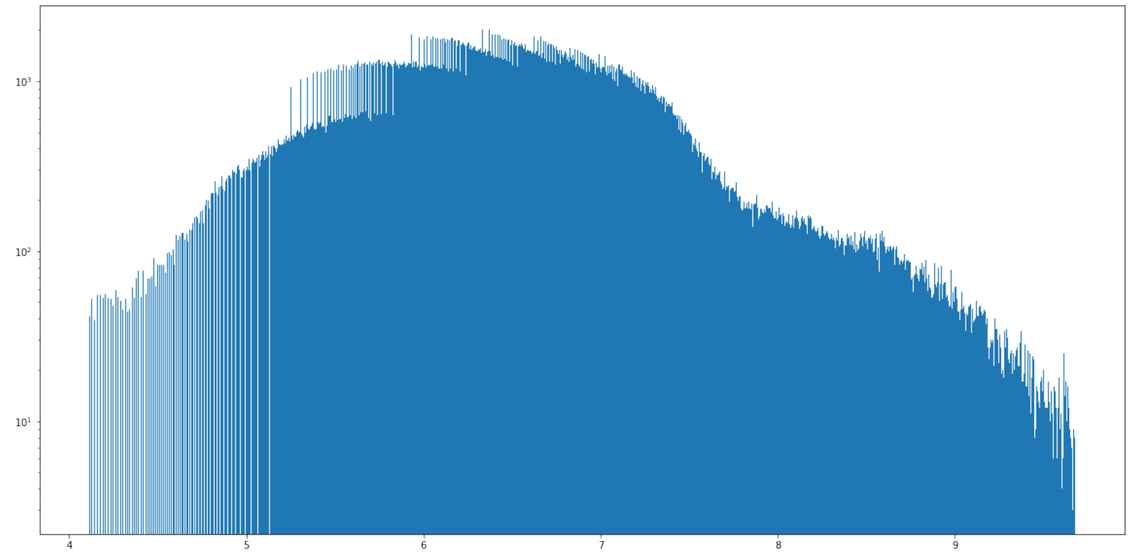
```
[5]: plt.rcParams['figure.figsize'] = 20, 10
```

```
[6]: _=plt.hist(bikes[bikes.dur<16000].dur, log=True, bins=1000)
```



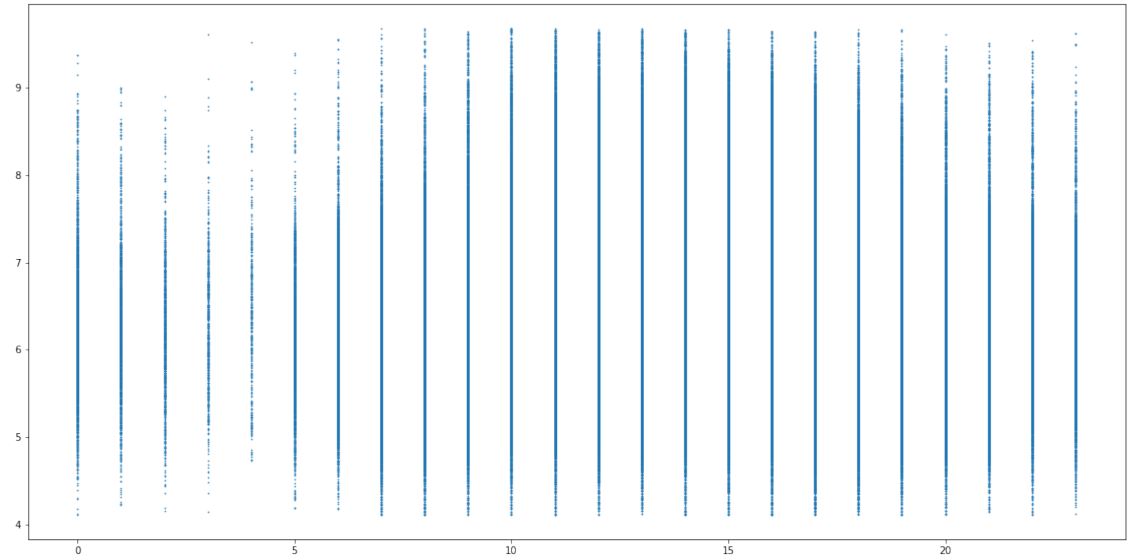
[7]:
```
short = bikes[bikes.dur<16000]
```

[8]:
```
_=plt.hist(np.log1p(short.dur), log=True, bins=1000)
```



[9]:
```
plt.scatter(short.start.dt.hour, np.log1p(short.dur), s=.4)
```

[9]:
```
<matplotlib.collections.PathCollection at 0x1a263075c0>
```



```
[10]: np.log1p(0), np.log(0)
```

```
/Users/Carancho/miniconda3/envs/hw4/lib/python3.6/site-
packages/ipykernel_launcher.py:1: RuntimeWarning: divide by zero encountered in
log
  """Entry point for launching an IPython kernel.
```

```
[10]: (0.0, -inf)
```

```
[11]: bikes['log_dur'] = np.round(np.log1p(bikes.dur), 1)
```

```
[12]: monday = bikes[bikes.start.dt.dayofweek==1]
```

```
[13]: dur_hour = monday.groupby(['log_dur', monday.start.dt.hour]).count()
```

```
[14]: dur_hour
```

```
[14]:
               Duration (ms)  Start date  End date  Start station number  \
log_dur start
4.1     7                  1           1         1                     1
        9                  2           2         2                     2
        11                 1           1         1                     1
        14                 2           2         2                     2
        16                 2           2         2                     2
…                      …         …       …                    …
11.2    21                 2           2         2                     2
11.3    14                 1           1         1                     1
        17                 1           1         1                     1
        19                 1           1         1                     1
11.4    18                 1           1         1                     1

               Start station  End station number  End station  Bike number  \
log_dur start
4.1     7                  1                   1            1            1
        9                  2                   2            2            2
        11                 1                   1            1            1
        14                 2                   2            2            2
        16                 2                   2            2            2
…                      …                 …          …          …
11.2    21                 2                   2            2            2
11.3    14                 1                   1            1            1
        17                 1                   1            1            1
        19                 1                   1            1            1
11.4    18                 1                   1            1            1

               Member Type  start  end  dur
log_dur start
```

```
4.1     7                 1       1     1     1
        9                 2       2     2     2
        11                1       1     1     1
        14                2       2     2     2
        16                2       2     2     2
…                    …     …   …    …
11.2    21                2       2     2     2
11.3    14                1       1     1     1
        17                1       1     1     1
        19                1       1     1     1
11.4    18                1       1     1     1

[1184 rows x 12 columns]
```

[15]:

```
duration_hour = dur_hour.start.unstack().T.fillna(0)
duration_hour
```

[15]:

```
log_dur  4.1   4.2   4.3   4.4   4.5   4.6   4.7   4.8   4.9   5.0   …  \
start                                                                 …
0          0.0   0.0   0.0   0.0   0.0   1.0   1.0   1.0   2.0   3.0  …
1          0.0   0.0   1.0   1.0   0.0   0.0   0.0   0.0   3.0   1.0  …
2          0.0   0.0   0.0   0.0   0.0   0.0   0.0   2.0   0.0   0.0  …
3          0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0  …
4          0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   1.0  …
5          0.0   0.0   1.0   0.0   0.0   1.0   4.0   1.0   7.0   6.0  …
6          0.0   0.0   0.0   2.0   1.0   2.0   4.0   9.0  11.0  21.0  …
7          1.0   5.0   4.0   1.0   5.0  12.0  25.0  31.0  46.0  46.0  …
8          0.0   3.0   2.0   6.0   7.0  11.0  22.0  52.0  68.0  79.0  …
9          2.0   3.0   2.0   4.0   3.0  11.0  18.0  22.0  28.0  42.0  …
10         0.0   0.0   1.0   3.0   5.0   7.0   8.0   5.0  10.0  31.0  …
11         1.0   0.0   2.0   5.0   4.0   7.0   7.0  10.0  13.0  22.0  …
12         0.0   0.0   4.0   2.0   7.0   6.0  12.0  16.0  36.0  30.0  …
13         0.0   2.0   6.0   3.0   5.0   6.0   4.0  15.0  20.0  36.0  …
14         2.0   0.0   1.0   1.0   3.0   8.0   9.0  11.0  26.0  24.0  …
15         0.0   3.0   0.0   5.0   1.0   7.0   6.0  22.0  26.0  31.0  …
16         2.0   6.0   1.0  11.0   6.0  10.0  14.0  17.0  36.0  35.0  …
17         3.0   7.0   7.0  13.0  12.0  14.0  20.0  36.0  57.0  71.0  …
18         0.0   4.0   7.0   9.0  13.0  20.0  21.0  40.0  79.0  75.0  …
19         3.0   0.0   7.0   7.0   9.0  16.0  19.0  34.0  43.0  52.0  …
20         0.0   7.0   2.0   4.0   2.0  13.0  14.0  19.0  34.0  38.0  …
21         1.0   2.0   1.0   2.0   3.0   6.0  16.0  19.0  26.0  35.0  …
22         1.0   0.0   2.0   2.0   1.0   8.0   1.0  13.0  10.0  20.0  …
23         0.0   0.0   1.0   0.0   2.0   5.0   4.0   8.0   3.0   5.0  …

log_dur  10.5  10.6  10.7  10.8  10.9  11.0  11.1  11.2  11.3  11.4
start
0          0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
```

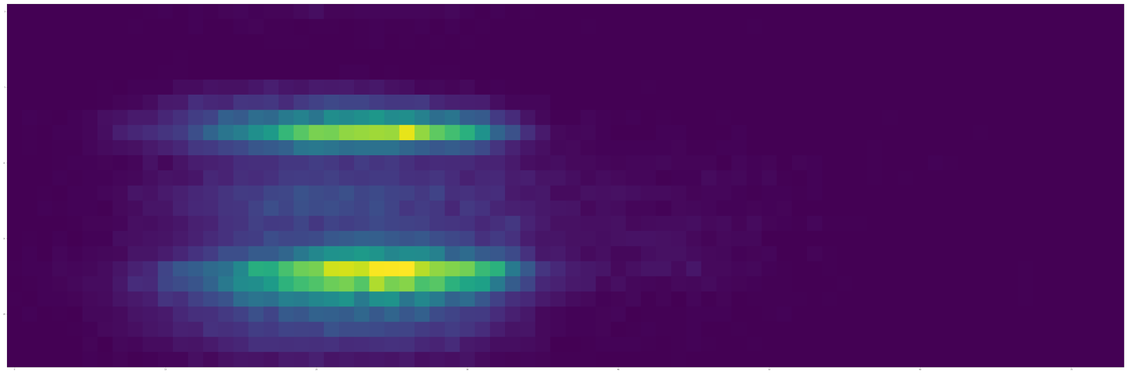
```
1          0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
2          0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
3          0.0   0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0
4          0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
5          0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
6          0.0   0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0
7          0.0   1.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
8          4.0   2.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
9          1.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
10         0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
11         1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
12         0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
13         0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0
14         0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   1.0   0.0
15         0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
16         0.0   0.0   0.0   0.0   2.0   0.0   0.0   0.0   0.0   0.0
17         0.0   0.0   0.0   3.0   1.0   1.0   1.0   0.0   1.0   0.0
18         0.0   0.0   2.0   4.0   1.0   0.0   1.0   1.0   0.0   1.0
19         0.0   1.0   2.0   3.0   0.0   1.0   0.0   0.0   1.0   0.0
20         0.0   1.0   1.0   1.0   1.0   1.0   0.0   0.0   0.0   0.0
21         1.0   2.0   0.0   1.0   0.0   0.0   1.0   2.0   0.0   0.0
22         1.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
23         0.0   0.0   1.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0

[24 rows x 74 columns]
```

[16]:

```
plt.figure(figsize=(100,100))
plt.imshow(duration_hour)
```

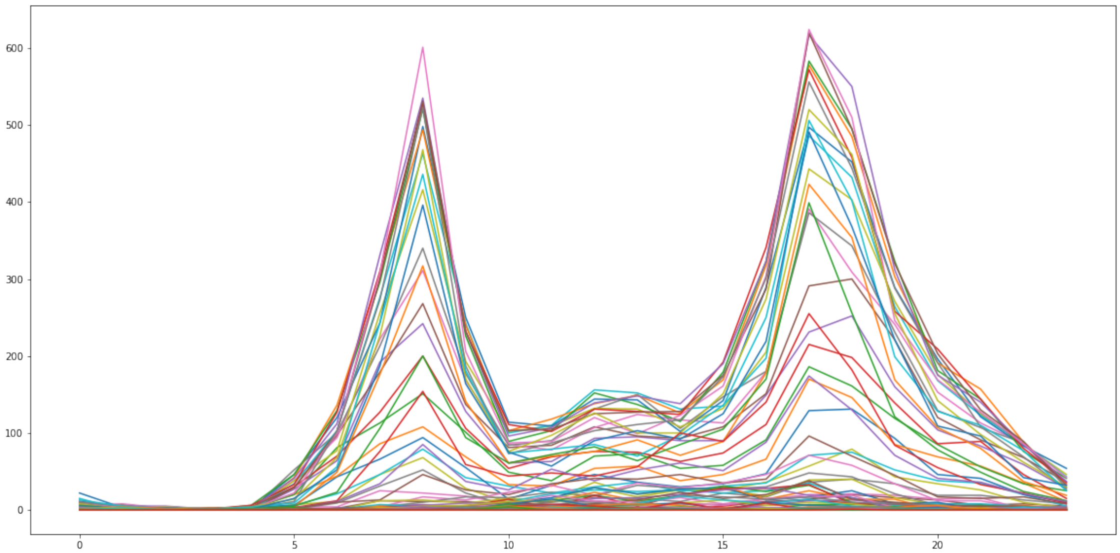
[16]:

```
<matplotlib.image.AxesImage at 0x1a26599668>
```



[17]:

```
_=plt.plot(duration_hour)
```



[18]:

```
bikes['Member Type'].value_counts()
```

[18]:

```
Registered    467432
Casual         84967
Name: Member Type, dtype: int64
```

1.1.2 Create a new column that represents the hour+minute of the day as a fraction (i.e. 1:30pm = 13.5)

[19]:

```
np.round(.65, 1)
```

[19]:

```
0.6
```

[20]:

```
37//6, (37//6)/10, 37/60
```

[20]:

```
(6, 0.6, 0.6166666666666667)
```

[21]:

```
bikes['hour_of_day'] = (bikes.start.dt.hour + (bikes.start.dt.minute//6)/10)
```

[22]:

```
bikes['roundhour_of_day'] = (bikes.start.dt.hour ) # keep the hour handy as well
```

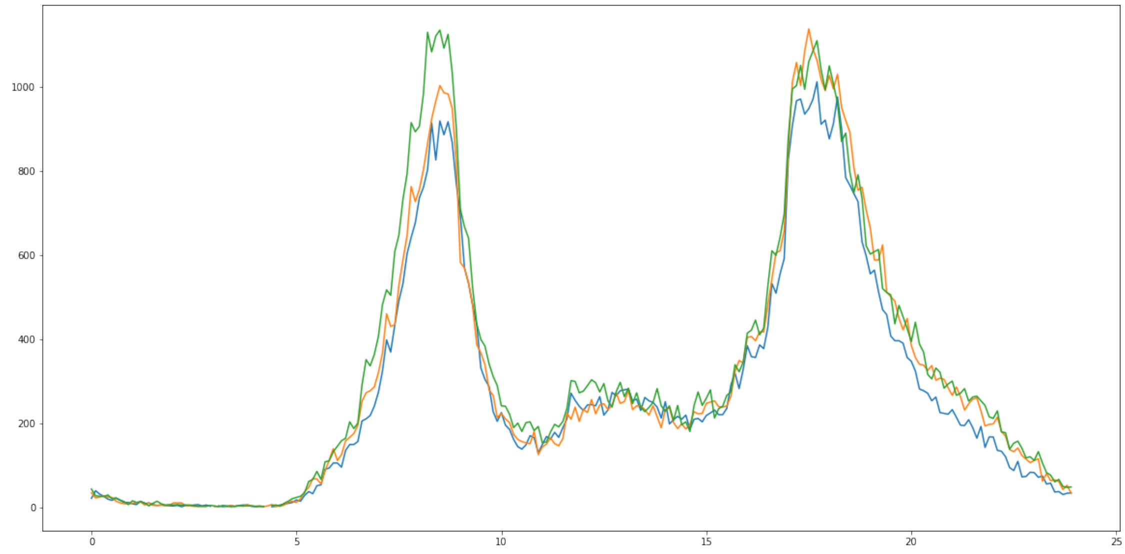
1.1.3 Aggregate to get a count per hour/minute of the day across all trips

[23]:

```
reg_bikes = bikes[bikes['Member Type']=='Registered']
hours = reg_bikes.groupby([reg_bikes.hour_of_day, reg_bikes.start.dt.
 ↪dayofweek]).agg('count')
hours['hour'] = hours.index
day_hour_count = hours.dur.unstack()
```

```
plt.figure(figsize=(20,10))
plt.plot(day_hour_count.index, day_hour_count[0])
plt.plot(day_hour_count.index, day_hour_count[1])
plt.plot(day_hour_count.index, day_hour_count[2])
plt.plot(y.index, day_hour_count[3])
plt.plot(y.index, day_hour_count[4])
plt.plot(y.index, day_hour_count[5])
plt.plot(y.index, day_hour_count[6])
```

```
       ␣
↪---------------------------------------------------------------------------

       NameError                                 Traceback (most recent call␣
↪last)

       <ipython-input-23-ce54367e3791> in <module>
         7 plt.plot(day_hour_count.index, day_hour_count[1])
         8 plt.plot(day_hour_count.index, day_hour_count[2])
   ----> 9 plt.plot(y.index, day_hour_count[3])
        10 plt.plot(y.index, day_hour_count[4])
        11 plt.plot(y.index, day_hour_count[5])


       NameError: name 'y' is not defined
```

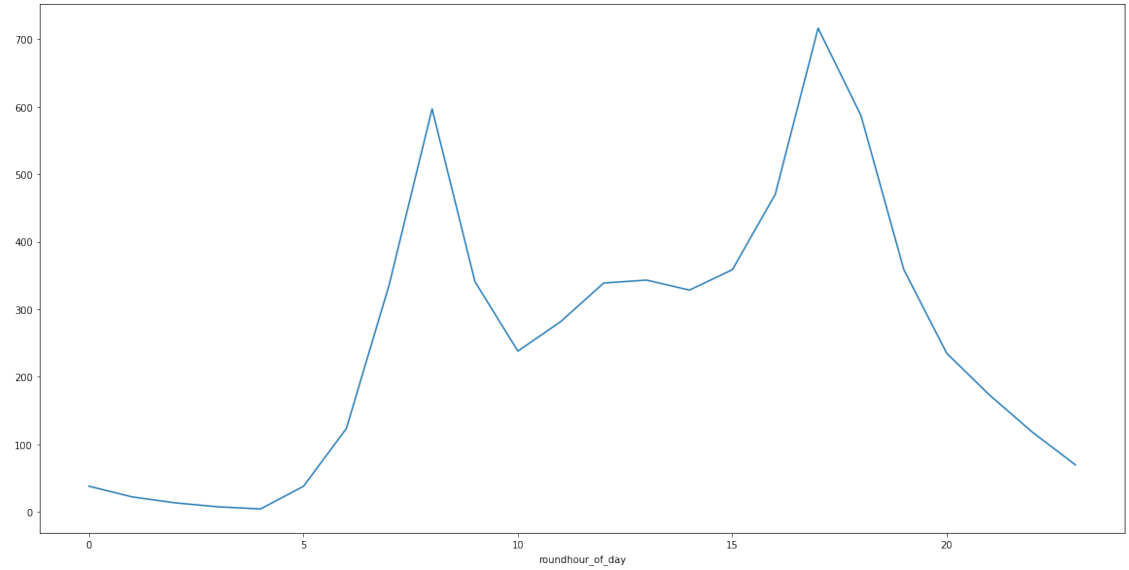


[29]:
```
day_hour_count
```

```
[29]: start            0     1     2      3      4      5      6
      hour_of_day
      0.0           21.0  34.0  43.0   47.0   51.0   89.0  106.0
      0.1           39.0  22.0  27.0   37.0   56.0   87.0  100.0
      0.2           31.0  24.0  26.0   42.0   50.0   98.0   77.0
      0.3           26.0  27.0  25.0   29.0   52.0   99.0   87.0
      0.4           19.0  24.0  29.0   29.0   50.0   98.0   69.0
      …            …   …    …     …     …     …     …
      23.5          36.0  65.0  60.0   94.0   80.0   93.0   28.0
      23.6          37.0  61.0  66.0  100.0   81.0   95.0   28.0
      23.7          30.0  42.0  49.0   80.0  101.0  105.0   27.0
      23.8          33.0  52.0  47.0   79.0   91.0   93.0   24.0
      23.9          34.0  33.0  48.0   65.0  105.0  111.0   23.0

      [240 rows x 7 columns]
```

```
[28]: hoursn = bikes.groupby('roundhour_of_day').agg('count')
      hoursn['hour'] = hoursn.index
      (hoursn.start/90).plot() # 90 days in a quarter
```

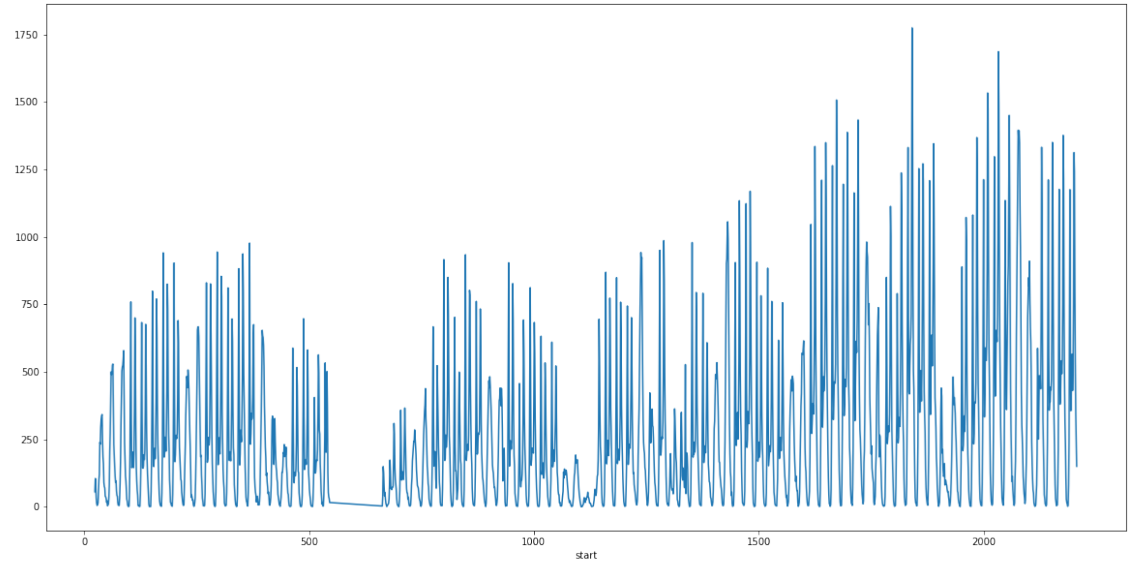
```
[28]: <matplotlib.axes._subplots.AxesSubplot at 0x1a23a1d358>
```



```
[26]: hour_count = bikes.groupby(bikes.start.dt.dayofyear*24 + bikes.start.dt.hour).
       ↪count()
```

```
[27]: plt.figure(figsize=(20,10))
      hour_count.start.plot()
```

```
[27]: <matplotlib.axes._subplots.AxesSubplot at 0x1a2624b780>
```



```
[30]: day_count = bikes.groupby(bikes.start.dt.dayofyear).count()
```

```
[31]: day_hour = bikes.groupby([bikes.start.dt.dayofyear, bikes.start.dt.hour]).
       ↪count()
```

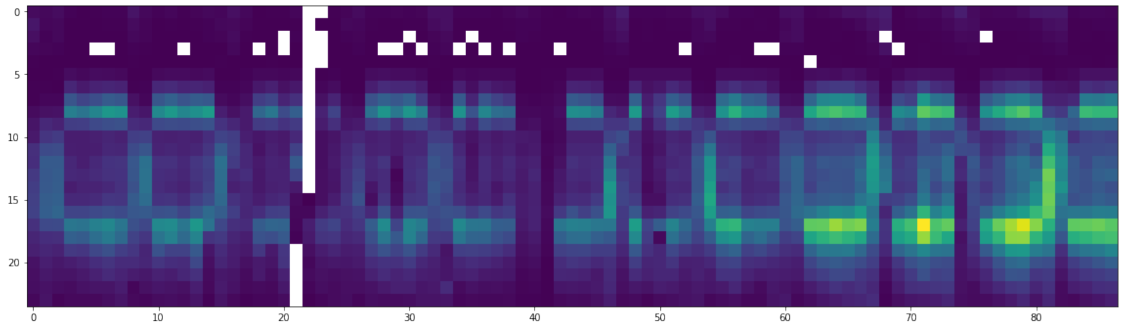
```
[32]: day_hour.start.unstack()
```

```
[32]: start      0      1     2     3     4     5      6      7       8      9  …  \
      start                                                                      …
      1       56.0  105.0  74.0  32.0  13.0   5.0   10.0   14.0    54.0  101.0  …
      2       37.0   31.0  17.0  23.0   4.0   7.0   10.0   34.0    80.0  203.0  …
      3       59.0   42.0  39.0  15.0   6.0   9.0    5.0   33.0    87.0  168.0  …
      4       20.0    6.0   2.0   1.0   3.0  58.0  192.0  468.0   759.0  321.0  …
      5        5.0    5.0   3.0   1.0   2.0  42.0  131.0  363.0   683.0  329.0  …
      …          …     …     …     …     …     …      …      …     …      …  …
      87     113.0   82.0  50.0  34.0  12.0  24.0   94.0  166.0   297.0  509.0  …
      88      15.0    7.0   2.0   3.0   8.0  42.0   81.0  197.0   587.0  464.0  …
      89      31.0   11.0   9.0   3.0   8.0  79.0  240.0  727.0  1211.0  564.0  …
      90      31.0   18.0   4.0   6.0   7.0  79.0  215.0  703.0  1176.0  593.0  …
      91      28.0   16.0  10.0   2.0   8.0  80.0  240.0  750.0  1175.0  589.0  …

      start     14     15     16      17      18     19     20     21     22     23
      start
      1      324.0  338.0  342.0   247.0   185.0  160.0   90.0   75.0   70.0   39.0
      2      495.0  525.0  529.0   392.0   232.0  188.0  150.0  114.0   91.0   96.0
      3      524.0  546.0  579.0   398.0   237.0  172.0  115.0   96.0   64.0   28.0
```

```
4      145.0  206.0  365.0   700.0   547.0  293.0  146.0   96.0   62.0   44.0
5      175.0  208.0  365.0   676.0   519.0  279.0  178.0  122.0   86.0   45.0
…      …    …    …     …     …    …    …    …    …    …
87     910.0  761.0  667.0   611.0   475.0  243.0  158.0  101.0   62.0   51.0
88     481.0  437.0  696.0  1332.0  1113.0  620.0  324.0  226.0  148.0   45.0
89     433.0  473.0  700.0  1350.0  1159.0  700.0  400.0  279.0  178.0   82.0
90     493.0  545.0  749.0  1376.0  1215.0  722.0  468.0  312.0  231.0  108.0
91     431.0  504.0  746.0  1312.0  1241.0  806.0  536.0  345.0  240.0  150.0

[87 rows x 24 columns]
```

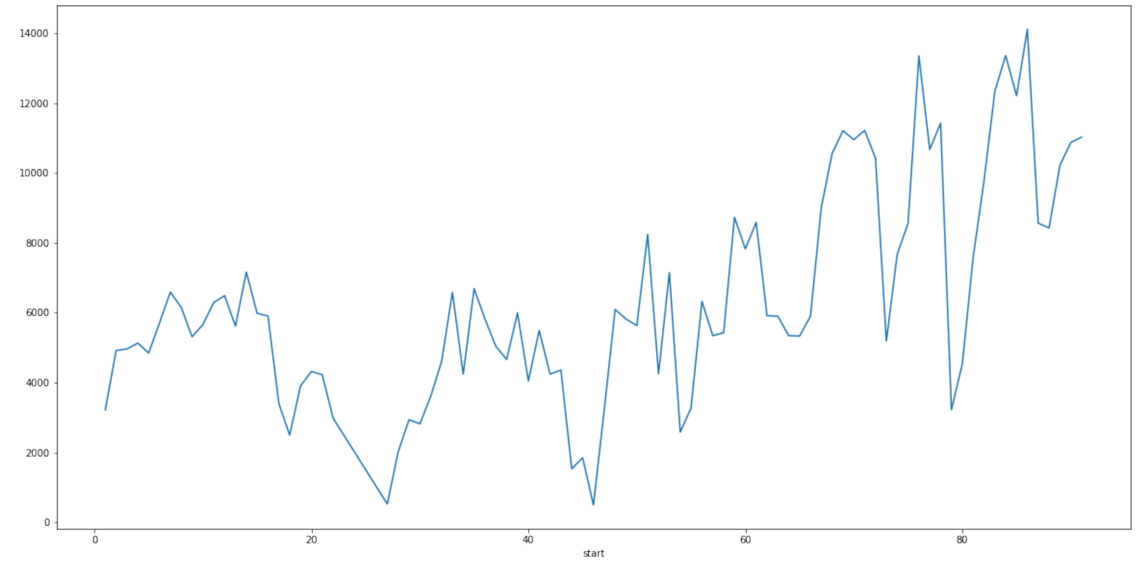
[33]:
```
plt.figure(figsize=(20,10))
plt.imshow(day_hour.start.unstack().T)
```

[33]:
```
<matplotlib.image.AxesImage at 0x1a23969f28>
```



[34]:
```
day_count.start.plot()
```

[34]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1a23948400>
```



```
[35]: bikes.start.dt.dayofyear
```

```
[35]: 0          91
      1          91
      2          91
      3          91
      4          91
                 ..
      552394      1
      552395      1
      552396      1
      552397      1
      552398      1
      Name: start, Length: 552399, dtype: int64
```

```
[36]: bikes[bikes.start=="2016-01-10"].shape
```

```
[36]: (1, 15)
```

2 Assignment 4

Explain the results in a **paragraph + charts** of to describe which model you'd recommend. This means show the data and the model's line on the same chart. The paragraph is a simple justification and comparison of the several models you tried.

2.1 1. Using the `day_hour_count` dataframe create two dataframe `monday` and `saturday` that represent the data for those days. (hint: Monday is day=0)

```
[85]: monday = pd.DataFrame(day_hour_count[0]).reset_index().dropna()
      saturday = pd.DataFrame(day_hour_count[5]).reset_index().dropna()
      monday.columns = ['hour','monday']
      saturday.columns = ['hour','saturday']
      monday,saturday
```

```
[85]: (     hour  monday
       0     0.0    21.0
       1     0.1    39.0
       2     0.2    31.0
       3     0.3    26.0
       4     0.4    19.0
       ..    …      …
       235  23.5    36.0
       236  23.6    37.0
       237  23.7    30.0
       238  23.8    33.0
       239  23.9    34.0

       [238 rows x 2 columns],
            hour  saturday
       0     0.0      89.0
       1     0.1      87.0
       2     0.2      98.0
       3     0.3      99.0
       4     0.4      98.0
       ..    …        …
       235  23.5      93.0
       236  23.6      95.0
       237  23.7     105.0
       238  23.8      93.0
       239  23.9     111.0

       [240 rows x 2 columns])
```

2.2 2a. Create 3 models fit to `monday` with varying polynomial degrees. Repeat for

```
[195]: from sklearn.preprocessing import PolynomialFeatures
       from sklearn import linear_model

       # create 3 sep groups from the monday data to build 3 models.
       mon_group_1 = monday.iloc[0:79:,]
       mon_group_2 = monday.iloc[78:158:,]
```

```
mon_group_3 = monday.iloc[157:,]

print(mon_group_1,mon_group_2,mon_group_3)
```

```
    hour  monday
0    0.0    21.0
1    0.1    39.0
2    0.2    31.0
3    0.3    26.0
4    0.4    19.0
..   ...     ...
76   7.6   532.0
77   7.7   603.0
78   7.8   642.0
79   7.9   676.0
80   8.0   736.0

[79 rows x 2 columns]      hour  monday
80    8.0   736.0
81    8.1   761.0
82    8.2   803.0
83    8.3   914.0
84    8.4   826.0
..    ...     ...
155  15.5   235.0
156  15.6   291.0
157  15.7   319.0
158  15.8   282.0
159  15.9   328.0

[80 rows x 2 columns]      hour  monday
159  15.9   328.0
160  16.0   384.0
161  16.1   358.0
162  16.2   356.0
163  16.3   386.0
..    ...     ...
235  23.5    36.0
236  23.6    37.0
237  23.7    30.0
238  23.8    33.0
239  23.9    34.0

[81 rows x 2 columns]
```

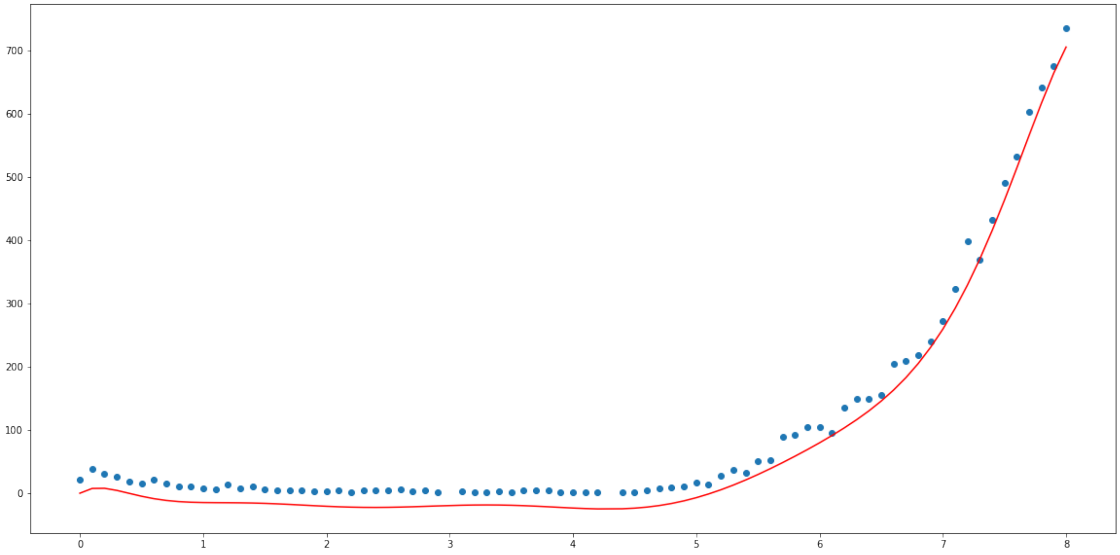
[185]:

```
# shape the data for linear regression.
mon_x1 = np.array(mon_group_1.hour).reshape(-1,1)
```

```
mon_y1 = np.array(mon_group_1.monday)


# create linear model.
poly1 = PolynomialFeatures(degree=11)
poly_x1 = poly1.fit_transform(mon_x1)
linear_1 = linear_model.LinearRegression()


# fit model to data
model_1 = linear_1.fit(poly_x1, mon_y1)
print(model_1.coef_, model_1.intercept_)

plt.scatter(mon_x1, mon_y1)
plt.plot(mon_x1, np.dot(poly_x1,linear_1.coef_), + linear_1.intercept_, c='r')
```

```
[ 0.00000000e+00  1.28845744e+02 -6.31024866e+02  1.09226658e+03
 -9.96474539e+02  5.41238367e+02 -1.85048334e+02  4.07305533e+01
 -5.74779479e+00  5.01341373e-01 -2.45540605e-02  5.15259645e-04]
24.052598988142194
```

```
[185]: [<matplotlib.lines.Line2D at 0x1a456c9c50>,
        <matplotlib.lines.Line2D at 0x1a4599b160>]
```

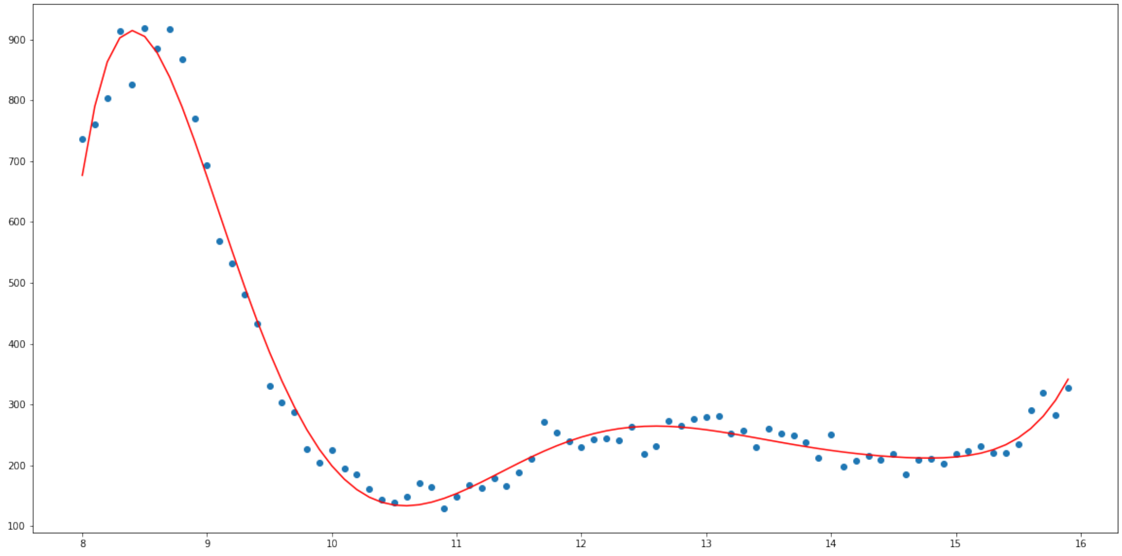


```
[202]: # shape the data for linear regression.
mon_x1 = np.array(mon_group_2.hour).reshape(-1,1)
mon_y1 = np.array(mon_group_2.monday)
```

```
# create linear model.
poly1 = PolynomialFeatures(degree=7)
poly_x1 = poly1.fit_transform(mon_x1)
linear_1 = linear_model.LinearRegression()


# fit model to data
model_1 = linear_1.fit(poly_x1, mon_y1)
print(model_1.coef_, model_1.intercept_)

plt.scatter(mon_x1, mon_y1)
plt.plot(mon_x1, np.dot(poly_x1,linear_1.coef_) + linear_1.intercept_, c='r')
```

```
[ 0.00000000e+00  3.34621738e+06 -8.31282954e+05  1.13574201e+05
 -9.22525487e+03  4.45882453e+02 -1.18829950e+01  1.34804403e-01]
-5708625.824810982
```

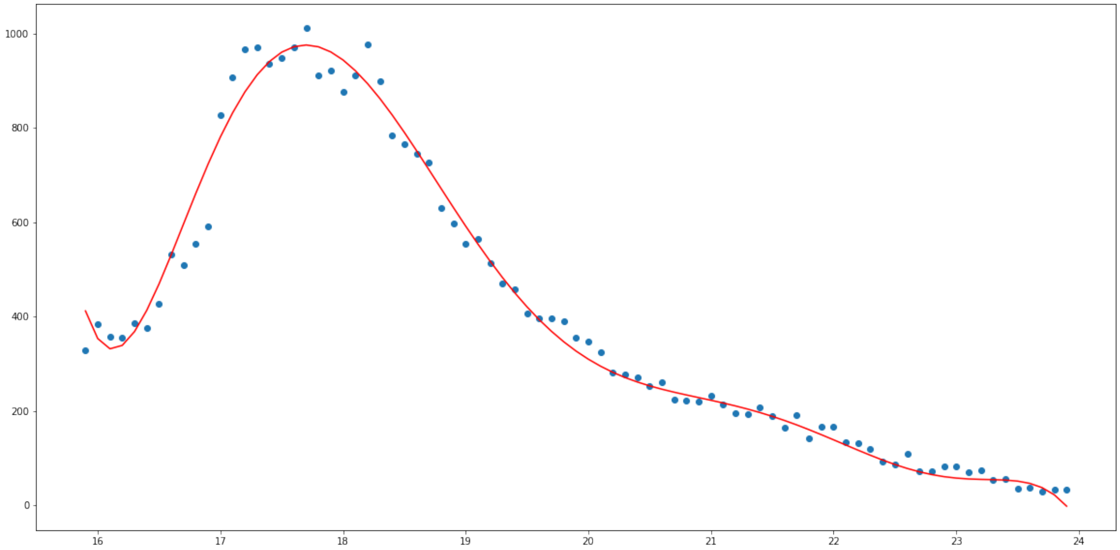
[202]:
```
[<matplotlib.lines.Line2D at 0x1a480df978>]
```



[216]:
```
# shape the data for linear regression.
mon_x3 = np.array(mon_group_3.hour).reshape(-1, 1)
mon_y3 = np.array(mon_group_3.monday)

poly = PolynomialFeatures(degree = 7)
poly_x = poly.fit_transform(mon_x3)

linear = linear_model.LinearRegression()
linear.fit(poly_x,mon_y3)
(linear.coef_, linear.intercept_)
```

```
plt.scatter(mon_x3, mon_y3)
plt.plot(mon_x3, np.dot(poly_x,linear.coef_) + linear.intercept_, c='r')
```

```
[216]: [<matplotlib.lines.Line2D at 0x1a4a2a2f98>]
```



2.3 2b. Repeat 2a for saturday

```
[222]: # organize saturday dataframe into 3 groups.
sat_1 = saturday.iloc[0:80:,]
sat_2 = saturday.iloc[80:160:,]
sat_3 = saturday.iloc[160:240:,]
(sat_1,sat_2,sat_3)
```

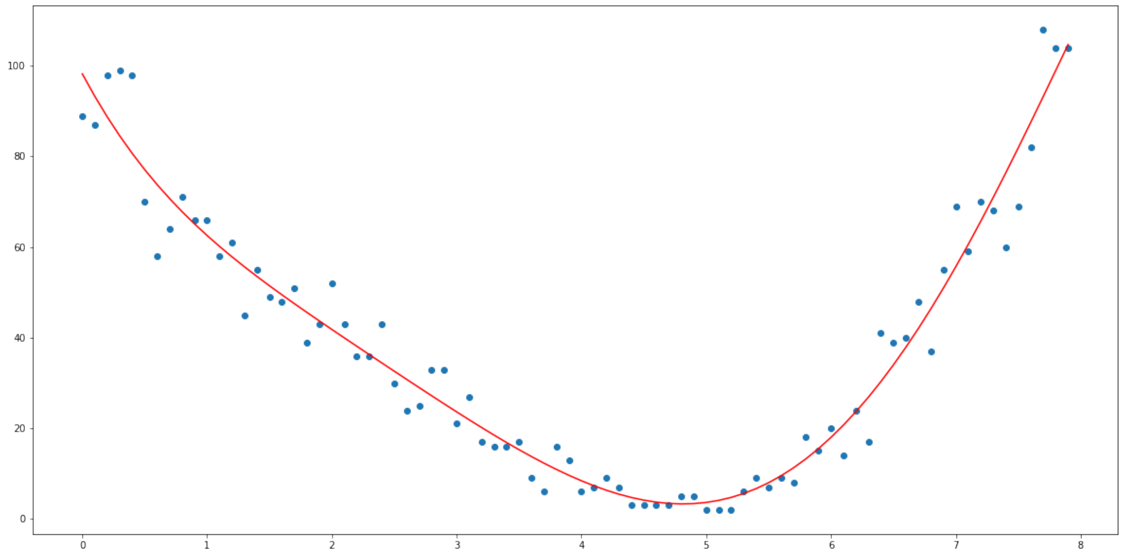
```
[222]: (    hour  saturday
 0    0.0      89.0
 1    0.1      87.0
 2    0.2      98.0
 3    0.3      99.0
 4    0.4      98.0
 ..   …         …
 75   7.5      69.0
 76   7.6      82.0
 77   7.7     108.0
 78   7.8     104.0
 79   7.9     104.0

 [80 rows x 2 columns],
      hour  saturday
 80    8.0     127.0
 81    8.1     134.0
 82    8.2     127.0
 83    8.3     145.0
 84    8.4     161.0
 ..    …       …
 155  15.5     442.0
 156  15.6     433.0
 157  15.7     446.0
 158  15.8     422.0
 159  15.9     425.0

 [80 rows x 2 columns],
      hour  saturday
 160  16.0     388.0
 161  16.1     401.0
 162  16.2     418.0
 163  16.3     426.0
 164  16.4     373.0
 ..    …       …
 235  23.5      93.0
 236  23.6      95.0
 237  23.7     105.0
 238  23.8      93.0
 239  23.9     111.0

 [80 rows x 2 columns])
```

[229]:

```
# Saturday group 1 linear regression model
sat_x1 = np.array(sat_1.hour).reshape(-1,1)
sat_y1 = np.array(sat_1.saturday)

# create linear model.
poly = PolynomialFeatures(degree = 5)
poly_x = poly.fit_transform(sat_x1)
linear = linear_model.LinearRegression()


# fit model to data.
model = linear.fit(poly_x, sat_y1)

# graph the model.
plt.scatter(sat_x1,sat_y1)
plt.plot(sat_x1, np.dot(poly_x,linear.coef_) + linear.intercept_, c = 'r')
```

[229]:

```
[<matplotlib.lines.Line2D at 0x1a4b4ddda0>]
```

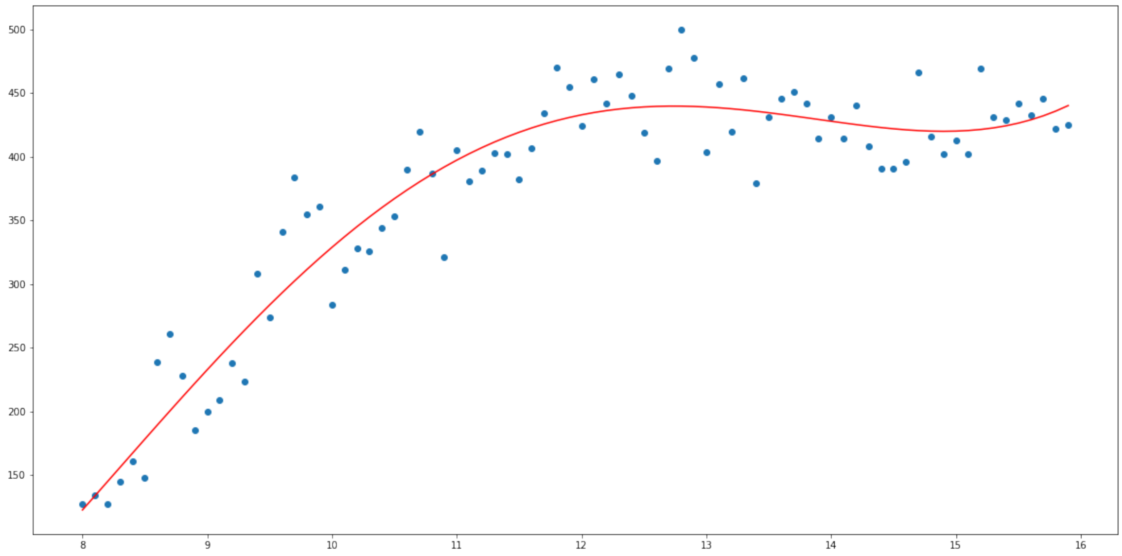


[238]:

```
# second group for saturday data.
sat_x2 = np.array(sat_2.hour).reshape(-1,1)
sat_y2 = np.array(sat_2.saturday)

# create linear model.
poly = PolynomialFeatures(degree = 4)
poly_x2 = poly.fit_transform(sat_x2)
linear = linear_model.LinearRegression()

# fit data to model.
model = linear.fit(poly_x2, sat_y2)

# graph the model.
plt.scatter(sat_x2, sat_y2)
plt.plot(sat_x2, np.dot(poly_x2, model.coef_) + model.intercept_, c = 'r' )
```

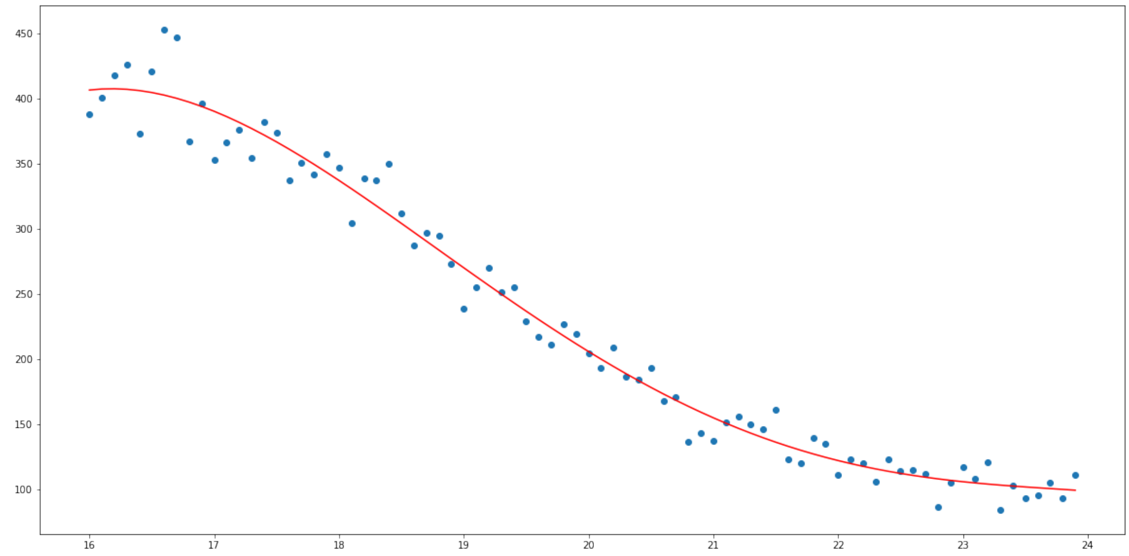
[238]:

```
[<matplotlib.lines.Line2D at 0x1a4c6faa58>]
```



[244]:
```
# last saturday group
sat_x3 = np.array(sat_3.hour).reshape(-1,1)
sat_y3 = np.array(sat_3.saturday)

# create models.
poly = PolynomialFeatures(degree = 4)
poly_x3 = poly.fit_transform(sat_x3)
linear = linear_model.LinearRegression()

# fit the data.
model = linear.fit(poly_x3, sat_y3)

# graph the results.
plt.scatter(sat_x3, sat_y3)
plt.plot(sat_x3, np.dot(poly_x3, linear.coef_) + linear.intercept_, c = 'r')
```

[244]:
```
[<matplotlib.lines.Line2D at 0x1a4d306e80>]
```



2.4 3. (for both `monday` and `saturday`) Choose one of the polynomial models and create 3 new models fit to `hour_of_day` with different Ridge Regression α (alpha) Ridge Coefficient values

[ ]:

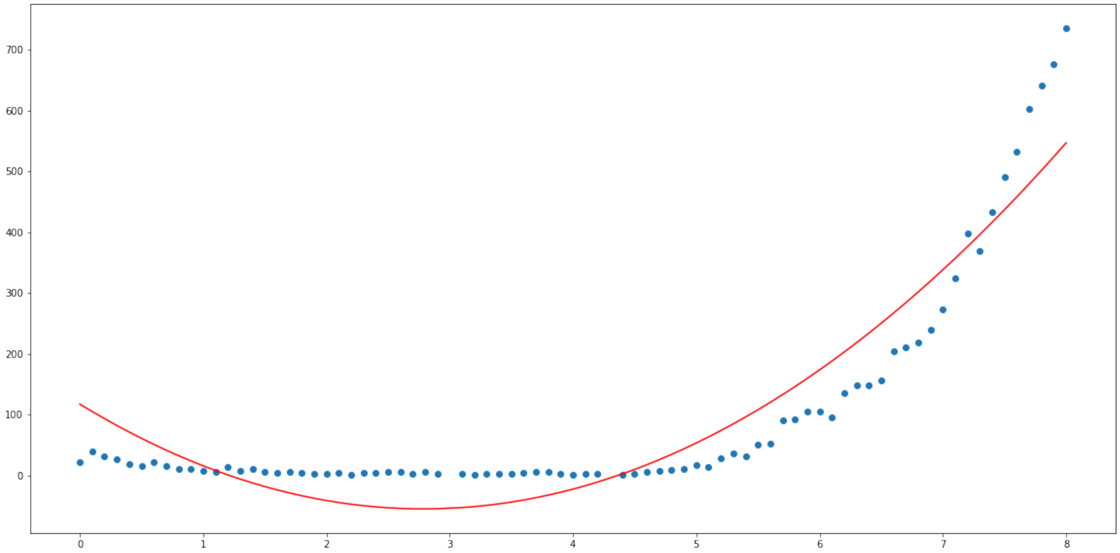
```
```

[280]:

```
#Monday

# shape the data for ridge regression.
mon_x1 = np.array(mon_group_1.hour).reshape(-1,1)
mon_y1 = np.array(mon_group_1.monday)
print(mon_x1.shape, mon_y1.shape)

# create ridge object.
poly = PolynomialFeatures()
poly_x = poly.fit_transform(mon_x1)

# ridge object
ridge = linear_model.Ridge(alpha = .1)
model = ridge.fit(poly_x, mon_y1)
print(ridge.coef_,ridge.intercept_)

# plot the results.
plt.scatter(mon_x1, mon_y1)
plt.plot(mon_x1, np.dot(poly_x,model.coef_) + model.intercept_, c = 'r')
```

```
(79, 1) (79,)
[   0.         -123.6555867    22.17307687] 117.19893830138116
```

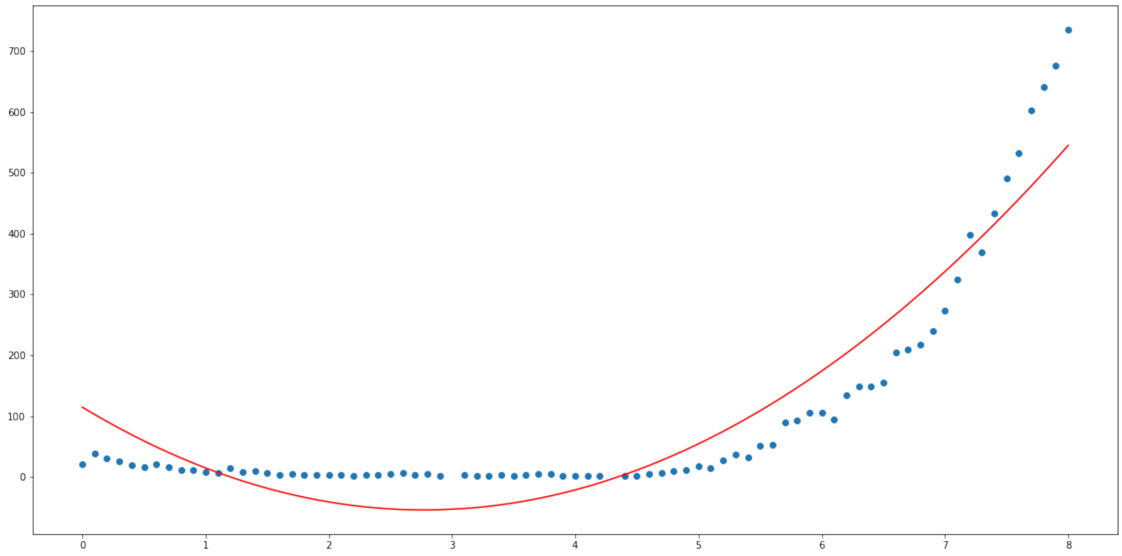
```
[280]: [<matplotlib.lines.Line2D at 0x1a53b18e80>]
```



```
[281]: #Monday

       # shape the data for ridge regression.
       mon_x1 = np.array(mon_group_1.hour).reshape(-1,1)
       mon_y1 = np.array(mon_group_1.monday)
       print(mon_x1.shape, mon_y1.shape)

       # create ridge object.
       poly = PolynomialFeatures()
       poly_x = poly.fit_transform(mon_x1)

       # ridge object
       ridge = linear_model.Ridge(alpha = .5)
       model = ridge.fit(poly_x, mon_y1)
       print(ridge.coef_,ridge.intercept_)

       # plot the results.
       plt.scatter(mon_x1, mon_y1)
       plt.plot(mon_x1, np.dot(poly_x,model.coef_) + model.intercept_, c = 'r')
```

```
(79, 1) (79,)
[   0.          -121.86276122   21.96254236] 114.57238123140374
```

```
[281]: [<matplotlib.lines.Line2D at 0x1a53e33c88>]
```



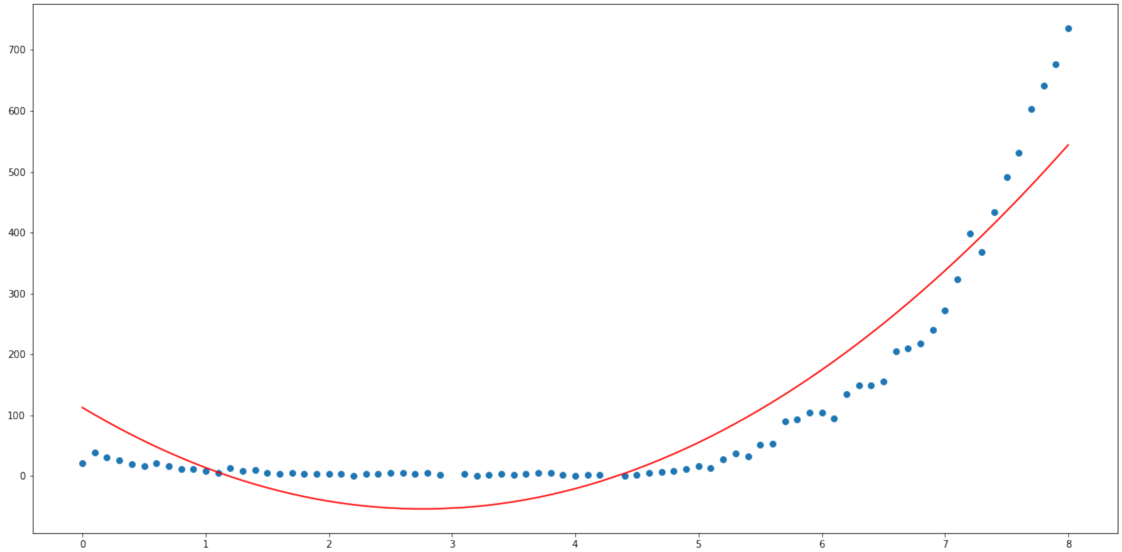
[282]:

```
#Monday

# shape the data for ridge regression.
mon_x1 = np.array(mon_group_1.hour).reshape(-1,1)
mon_y1 = np.array(mon_group_1.monday)
print(mon_x1.shape, mon_y1.shape)

# create ridge object.
poly = PolynomialFeatures()
poly_x = poly.fit_transform(mon_x1)

# ridge object
ridge = linear_model.Ridge(alpha = .8)
model = ridge.fit(poly_x, mon_y1)
print(ridge.coef_,ridge.intercept_)

# plot the results.
plt.scatter(mon_x1, mon_y1)
plt.plot(mon_x1, np.dot(poly_x,model.coef_) + model.intercept_, c = 'r')
```

```
(79, 1) (79,)
[   0.         -120.55165409   21.80857496] 112.65160036247343
```

[282]:

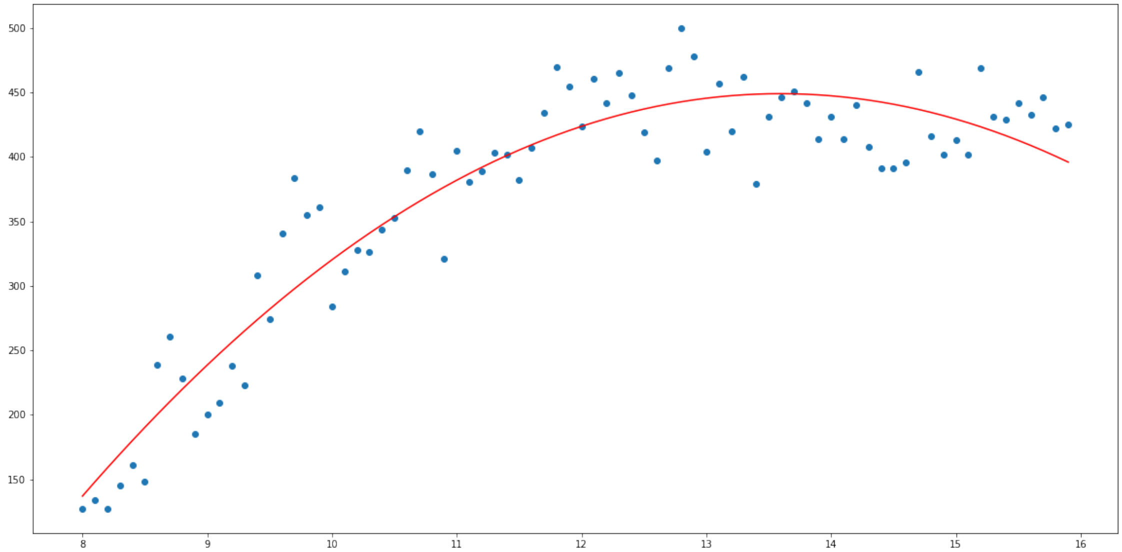
```
[<matplotlib.lines.Line2D at 0x1a5413d278>]
```



[283]:
```
#Saturday attempt 1
# second group for saturday data.
sat_x2 = np.array(sat_2.hour).reshape(-1,1)
sat_y2 = np.array(sat_2.saturday)


# create ridge object.
poly = PolynomialFeatures()
poly_x = poly.fit_transform(sat_x2)

# ridge object
ridge = linear_model.Ridge(alpha = .1)
model = ridge.fit(poly_x, sat_y2)
print(ridge.coef_,ridge.intercept_)

# plot the results.
plt.scatter(sat_x2, sat_y2)
plt.plot(sat_x2, np.dot(poly_x,model.coef_) + model.intercept_, c = 'r')
```

```
[   0.          271.29183281  -9.9788956 ] -1394.7637018658684
```

[283]:
```
[<matplotlib.lines.Line2D at 0x1a544406a0>]
```



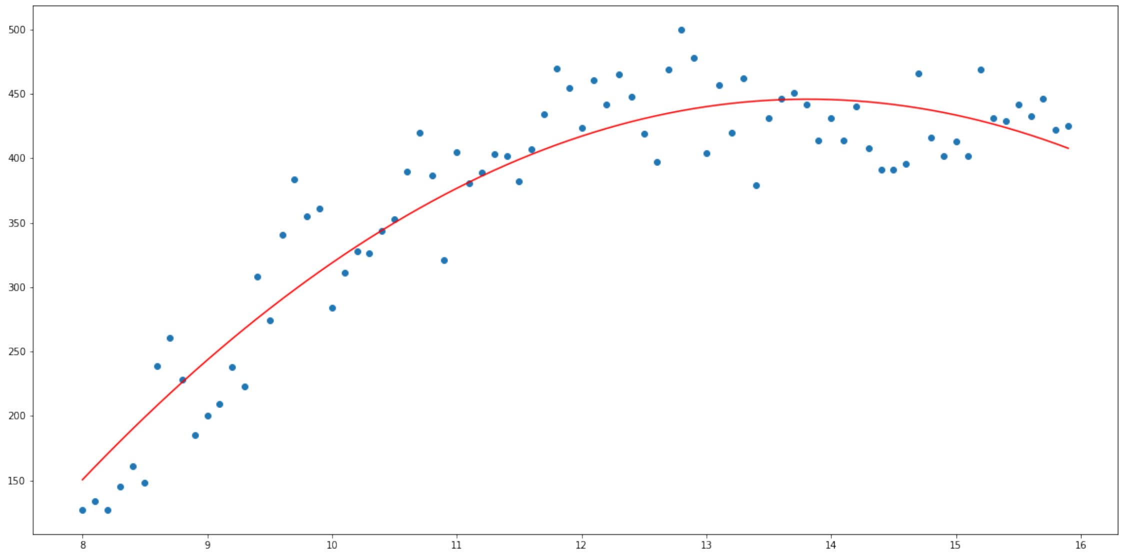
[284]:

```
#Saturday attempt 2
# second group for saturday data.
sat_x2 = np.array(sat_2.hour).reshape(-1,1)
sat_y2 = np.array(sat_2.saturday)


# create ridge object.
poly = PolynomialFeatures()
poly_x = poly.fit_transform(sat_x2)

# ridge object
ridge = linear_model.Ridge(alpha = .5)
model = ridge.fit(poly_x, sat_y2)
print(ridge.coef_,ridge.intercept_)

# plot the results.
plt.scatter(sat_x2, sat_y2)
plt.plot(sat_x2, np.dot(poly_x,model.coef_) + model.intercept_, c = 'r')
```

```
[  0.         241.61154451  -8.74623035] -1222.6851235457966
```

[284]:

```
[<matplotlib.lines.Line2D at 0x1a54746d30>]
```



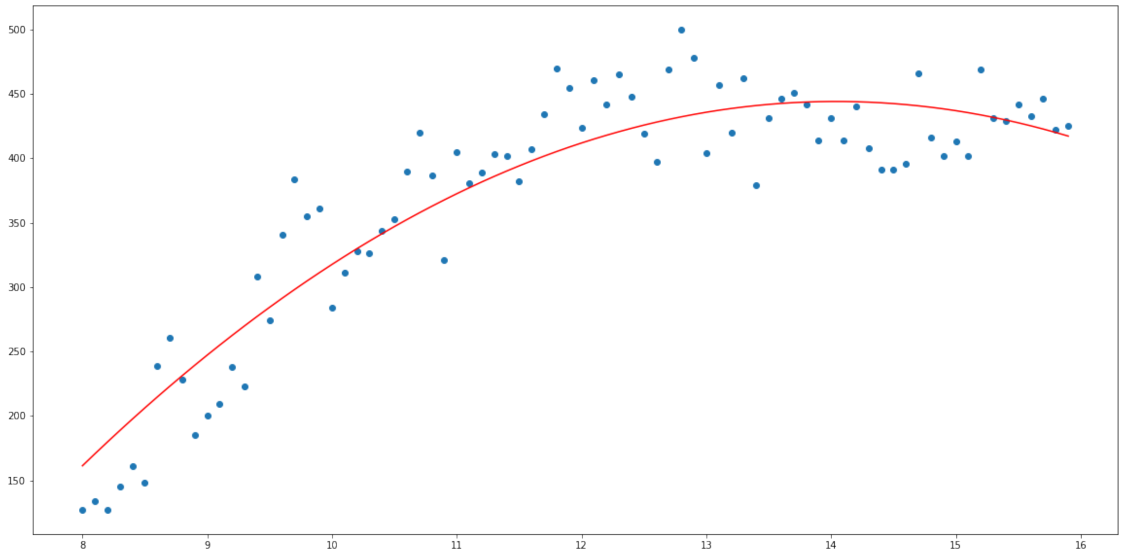
[285]:

```
#Saturday attempt 1
# second group for saturday data.
sat_x2 = np.array(sat_2.hour).reshape(-1,1)
sat_y2 = np.array(sat_2.saturday)



# create ridge object.
poly = PolynomialFeatures()
poly_x = poly.fit_transform(sat_x2)

# ridge object
ridge = linear_model.Ridge(alpha = .9)
model = ridge.fit(poly_x, sat_y2)
print(ridge.coef_,ridge.intercept_)

# plot the results.
plt.scatter(sat_x2, sat_y2)
plt.plot(sat_x2, np.dot(poly_x,model.coef_) + model.intercept_, c = 'r')
```

```
[  0.         217.78612319  -7.7567266 ] -1084.5514772633398
```

[285]:

```
[<matplotlib.lines.Line2D at 0x1a54a550b8>]
```


500
450
400
350
300
250
200
150
8
9
10
11
12
13
14
15
16

```
[ ]:
```