HW4

May 27, 2017

!pip3 install seaborn

I couldn't execute all the the utility programs you provided in HW4. So I went ahead and loaded the Bike Sahre data from pronto-data website.

```
In [4]: !pip install seaborn
        !pip install python-utils
```

```
Requirement already satisfied: seaborn in ./anaconda/lib/python3.5/site-packages
Collecting python-utils
  Downloading python_utils-2.1.0-py2.py3-none-any.whl
Requirement already satisfied: six in ./anaconda/lib/python3.5/site-packages (from
Installing collected packages: python-utils
Successfully installed python-utils-2.1.0
```

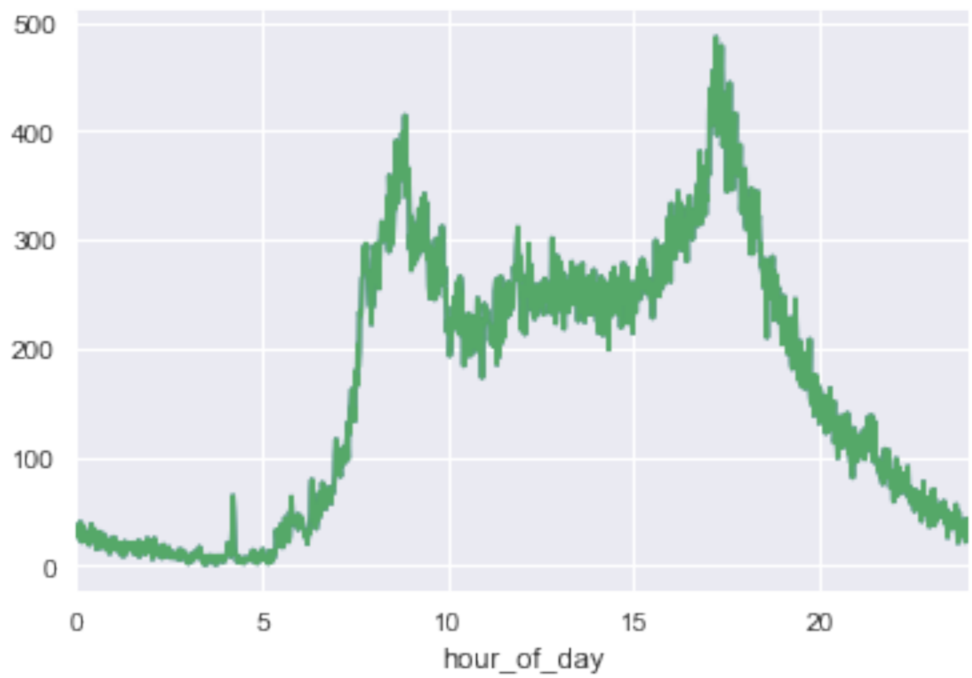
```
In [1]: !curl -O https://s3.amazonaws.com/pronto-data/open_data_year_two.zip
        !unzip open_data_year_two.zip
```

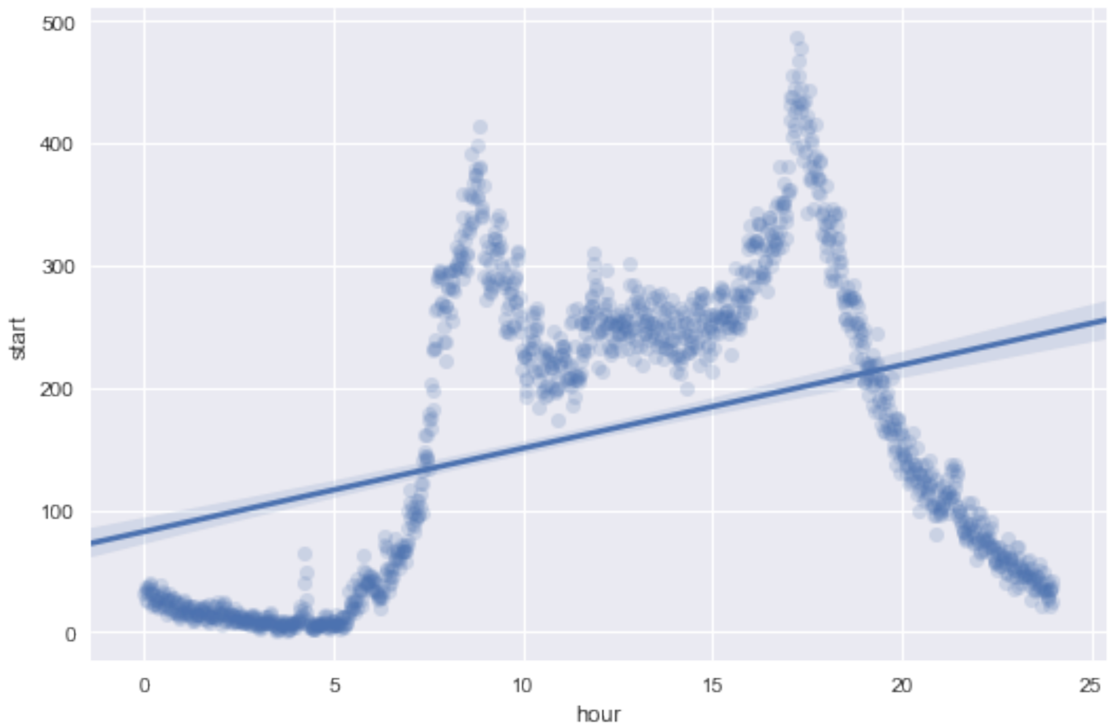
```
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100 5627k  100 5627k    0     0  1892k      0  0:00:02  0:00:02 --:--:-- 1993k
Archive:  open_data_year_two.zip
replace 2016_trip_data.csv? [y]es, [n]o, [A]ll, [N]one, [r]ename: ^C
```

```
In [2]: import seaborn as sns
        import matplotlib.pyplot as plt
        %matplotlib inline
        import pandas as pd
        bikes = pd.read_csv('2016_trip_data.csv',parse_dates=['starttime', 'stoptim
                            infer_datetime_format=True)

        bikes['start'] = pd.to_datetime(bikes['starttime'], infer_datetime_format=T
        bikes['end'] = pd.to_datetime(bikes['stoptime'], infer_datetime_format=True
        bikes['hour_of_day'] = (bikes.start.dt.hour + (bikes.start.dt.minute/60).ro
        bikes.head()

        hours = bikes.groupby('hour_of_day').agg('count')
```

```
hours['hour'] = hours.index

hours.start.plot()


hours.start.plot()
sns.lmplot(x='hour', y='start', data=hours, aspect=1.5, scatter_kws={'alpha
```

```
Out[2]: <seaborn.axisgrid.FacetGrid at 0x1110a52e8>
```



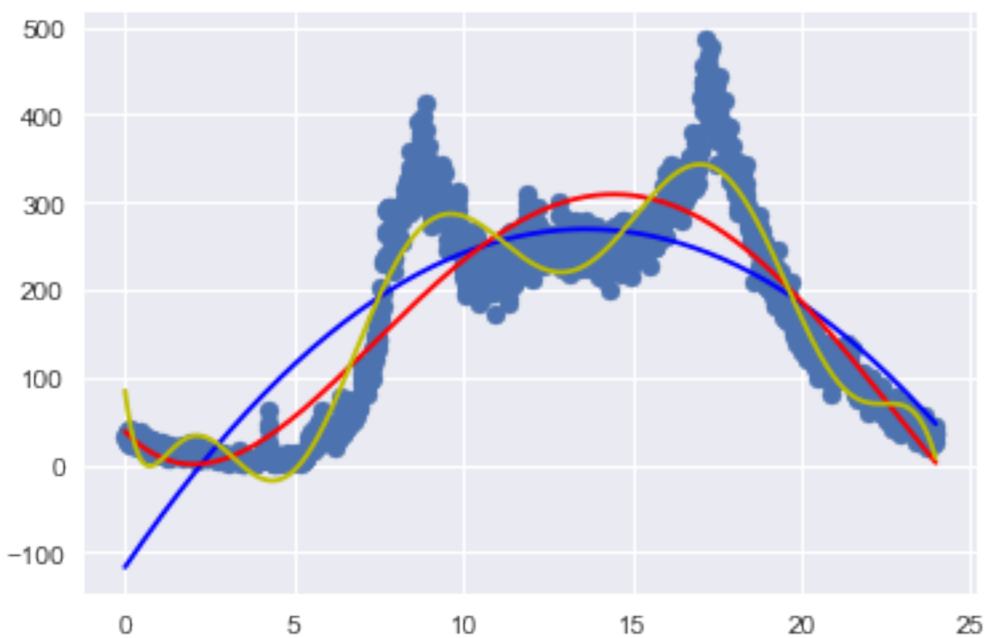


1. Create 3 models fit to hour_of_day with varying polynomial degrees

```
In [3]: from sklearn.preprocessing import PolynomialFeatures
        from sklearn import linear_model
        import numpy as np
        poly = PolynomialFeatures(degree=2)
        x = np.array(hours['hour']).reshape(-1,1)
        y = np.array(hours['start'])
        x2 = poly.fit_transform(x)
        M1 = linear_model.LinearRegression()
        M1.fit(x2, y)
        (M1.intercept_,M1.coef_)

        poly = PolynomialFeatures(degree=4)

        x4 = poly.fit_transform(x)
        M2 = linear_model.LinearRegression()
        M2.fit(x4, y)
        (M2.intercept_,M2.coef_)

        poly = PolynomialFeatures(degree=10)
        x10 = poly.fit_transform(x)
        M3 = linear_model.LinearRegression()
        M3.fit(x10, y)
```

```
(M3.intercept_,M3.coef_)

plt.scatter (x,y)
plt.plot(x,np.dot(x2,M1.coef_)+M1.intercept_,c='b')
plt.plot(x,np.dot(x4,M2.coef_)+M2.intercept_,c='r')
plt.plot(x,np.dot(x10,M3.coef_)+M3.intercept_,c='y')
```

```
Out[3]: [<matplotlib.lines.Line2D at 0x1129b29b0>]
```

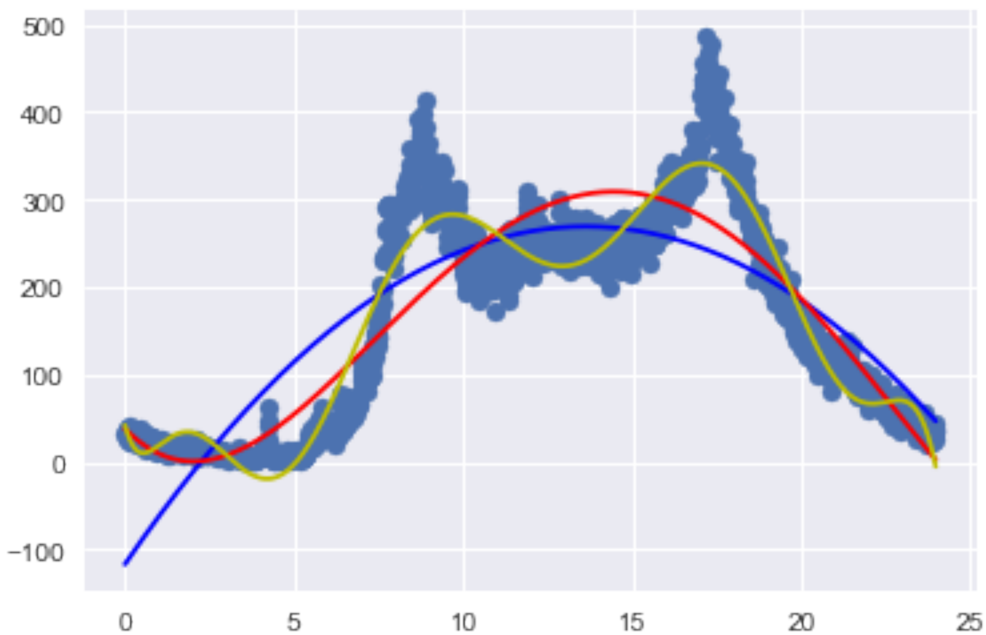


Choose one of the polynomial models and create 3 new models fit to hour_of_day with different Ridge Regression α (alpha) Ridge Coefficient values

```
In [4]: M1r = linear_model.Ridge(alpha = 0.1)
        M1r.fit(x2, y)
        (M1r.intercept_,M1r.coef_)

        poly = PolynomialFeatures(degree=4)
        M2r = linear_model.Ridge(alpha = 0.5)
        M2r.fit(x4, y)
        (M2r.intercept_,M2r.coef_)


        M3r = linear_model.Ridge(alpha = 0.6)
        M3r.fit(x10, y)
        (M3r.intercept_,M3r.coef_)

        plt.scatter (x,y)
```

```
plt.plot(x,np.dot(x2,M1r.coef_)+M1r.intercept_,c='b')
plt.plot(x,np.dot(x4,M2r.coef_)+M2r.intercept_,c='r')
plt.plot(x,np.dot(x10,M3r.coef_)+M3r.intercept_,c='y')
```

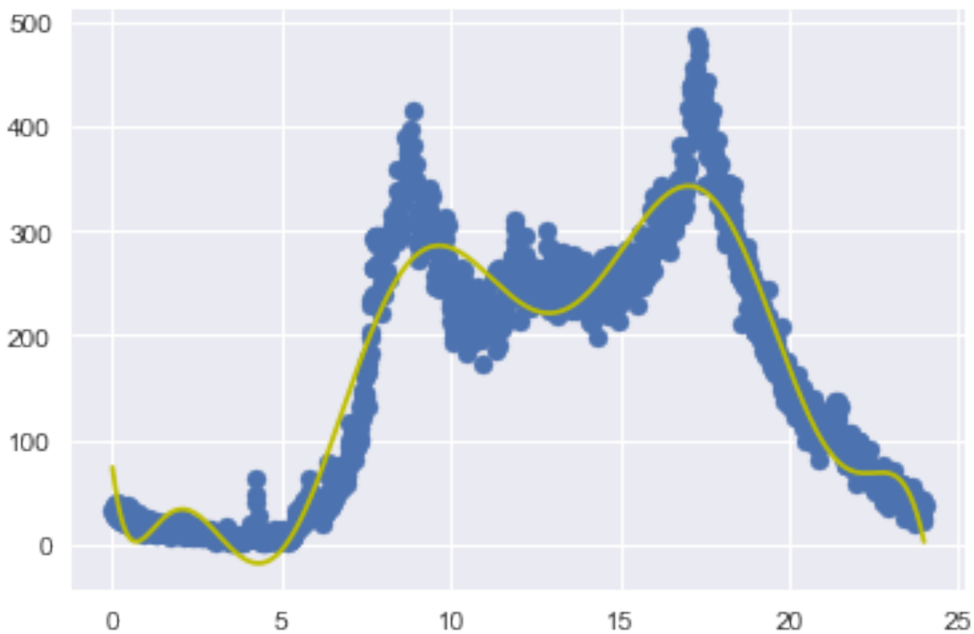
Out[4]: [<matplotlib.lines.Line2D at 0x112a35f98>]




```
In [10]: from sklearn import cross_validation
         import numpy as np
         from sklearn.metrics import mean_squared_error
         alphas = 10**np.linspace(10,-2,100)*0.5
         X_train, X_test , y_train, y_test = cross_validation.train_test_split(x10,
         ridgecv = linear_model.RidgeCV()
         ridgecv.fit(X_train, y_train)
         print(ridgecv.alpha_)
         M3r = linear_model.Ridge(alpha =ridgecv.alpha_ )
         M3r.fit(x10, y)
         print((M3r.intercept_,M3r.coef_))

         plt.scatter (x,y)
         plt.plot(x,np.dot(x10,M3r.coef_)+M3r.intercept_,c='y')

         pred2 = M3r.predict(X_test)
         print(mean_squared_error(y_test, pred2))
```

```
0.1
(73.653874953652519, array([  0.00000000e+00,  -2.59842321e+02,   3.25978778e+02,
```

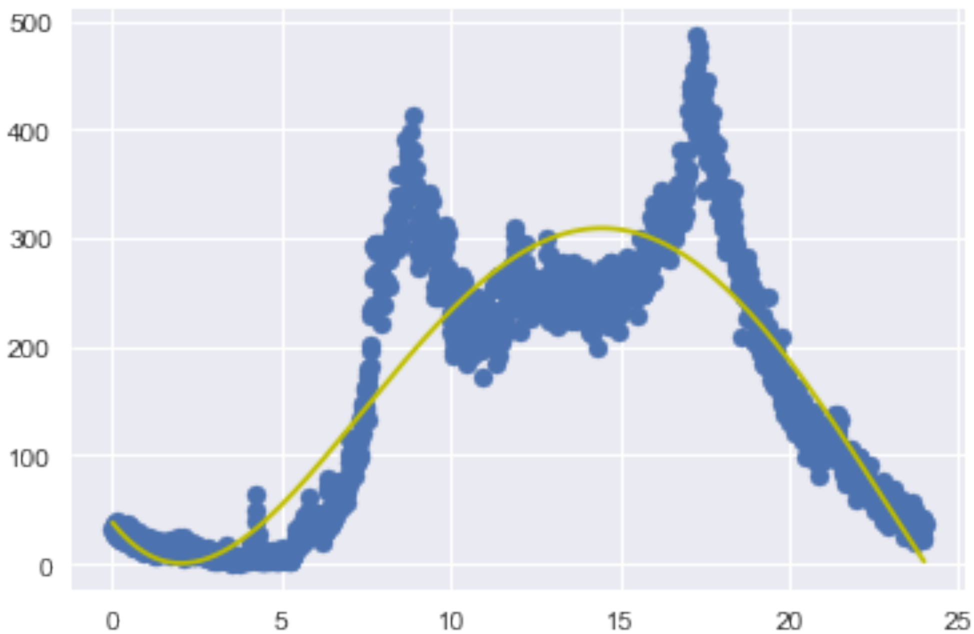
```
        -1.70658367e+02,   4.50080432e+01,  -6.65883267e+00,
         5.88657968e-01,  -3.17775732e-02,   1.02632952e-03,
        -1.82067736e-05,   1.36343847e-07]))
1281.73694429
```




```
In [12]: from sklearn import cross_validation
         import numpy as np
         from sklearn.metrics import mean_squared_error
         alphas = 10**np.linspace(10,-2,100)*0.5
         X_train, X_test , y_train, y_test = cross_validation.train_test_split(x4,
         ridgecv = linear_model.RidgeCV()
         ridgecv.fit(X_train, y_train)
         print(ridgecv.alpha_)
         M2r = linear_model.Ridge(alpha =ridgecv.alpha_ )
         M2r.fit(x4, y)
         print((M2r.intercept_,M2r.coef_))

         plt.scatter (x,y)
         plt.plot(x,np.dot(x4,M2r.coef_)+M2r.intercept_,c='y')

         pred1 = M2r.predict(X_test)
         print(mean_squared_error(y_test, pred1))
```

```
0.1
(38.144887182994069, array([  0.00000000e+00,  -3.96226930e+01,   1.18274210e+01,
```

```
         -7.08852053e-01,    1.17575804e-02]))
3395.06064824
```



Based on the MSE, I favor a modet with 10 polynomial degree, although the model with 4 degress is parsimunious

```
In [ ]:
```