We read in the data

In [202…]
```
import matplotlib.pyplot as plt
%matplotlib inline
plt.rcParams['figure.figsize'] = 20, 10
import pandas as pd
import numpy as np


day_hour_count = pd.read_csv("../data/bikeshare_hour_count.csv")
day_hour_count
```

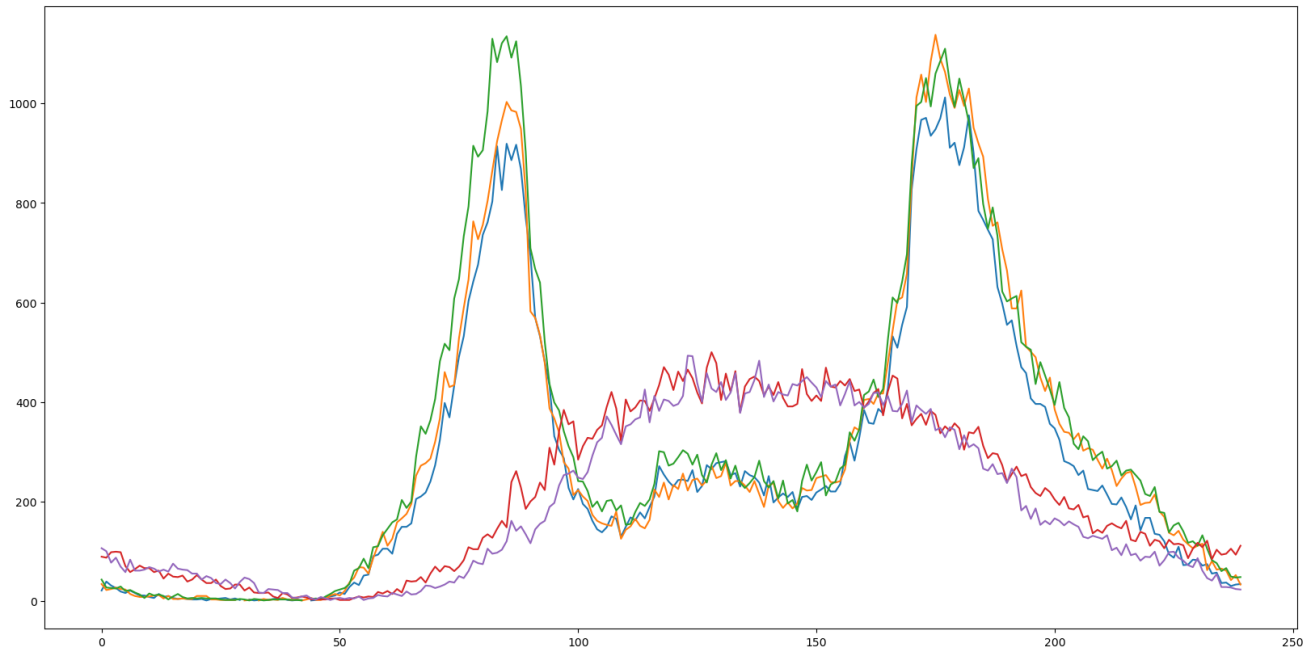
Out[202]:

	hour	monday	tuesday	wednesday	thursday	friday	saturday	sunday
0	0.0	21.0	34.0	43.0	47.0	51.0	89.0	106.0
1	0.1	39.0	22.0	27.0	37.0	56.0	87.0	100.0
2	0.2	31.0	24.0	26.0	42.0	50.0	98.0	77.0
3	0.3	26.0	27.0	25.0	29.0	52.0	99.0	87.0
4	0.4	19.0	24.0	29.0	29.0	50.0	98.0	69.0
...	...	...	...	...	...	...	...	...
235	23.5	36.0	65.0	60.0	94.0	80.0	93.0	28.0
236	23.6	37.0	61.0	66.0	100.0	81.0	95.0	28.0
237	23.7	30.0	42.0	49.0	80.0	101.0	105.0	27.0
238	23.8	33.0	52.0	47.0	79.0	91.0	93.0	24.0
239	23.9	34.0	33.0	48.0	65.0	105.0	111.0	23.0

240 rows × 8 columns

In [203…]
```
plt.figure(figsize=(20,10))
plt.plot(day_hour_count.index, day_hour_count["monday"])
plt.plot(day_hour_count.index, day_hour_count["tuesday"])
plt.plot(day_hour_count.index, day_hour_count["wednesday"])
plt.plot(day_hour_count.index, day_hour_count["saturday"])
plt.plot(day_hour_count.index, day_hour_count["sunday"])
```

Out[203]:
```
[<matplotlib.lines.Line2D at 0x1d932116fd0>]
```



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.

1. Using the `day_hour_count` dataframe create 4 dataframes `monday`, `tuesday`, `saturday` and `sunday` that represent the data for those days. (hint: Monday is day=0)

In [204…
```
monday = day_hour_count[["hour","monday"]].copy().fillna(0)
tuesday = day_hour_count[["hour", "tuesday"]].copy().fillna(0)
saturday = day_hour_count[["hour","saturday"]].copy().fillna(0)
sunday = day_hour_count[["hour", "sunday"]].copy().fillna(0)
```

In [205…
```
pd.options.display.max_rows = 10
monday
```

Out[205]:

	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

240 rows × 2 columns

In [206…
```
tuesday
```

Out[206]:

	hour	tuesday
0	0.0	34.0
1	0.1	22.0
2	0.2	24.0
3	0.3	27.0
4	0.4	24.0
...	...	...
235	23.5	65.0
236	23.6	61.0
237	23.7	42.0
238	23.8	52.0
239	23.9	33.0

240 rows × 2 columns

In [207…
```
saturday
```

Out[207]:

	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 × 2 columns

In [208…
```
sunday
```

Out[208]:

	hour	sunday
0	0.0	106.0
1	0.1	100.0
2	0.2	77.0
3	0.3	87.0
4	0.4	69.0
...	...	...
235	23.5	28.0
236	23.6	28.0
237	23.7	27.0
238	23.8	24.0
239	23.9	23.0

240 rows × 2 columns

2a. Create 3 models fit to (`x=hour` , `y=monday`) with varying polynomial degrees (choose from `n=5,15,20`). (Repeat for `saturday` below)

Plot all the results for each polynomial.

In [209…
```
from sklearn.preprocessing import PolynomialFeatures
from sklearn import linear_model, metrics

poly5 = PolynomialFeatures(degree=5)
poly15 = PolynomialFeatures(degree=15)
poly20 = PolynomialFeatures(degree=20)
```

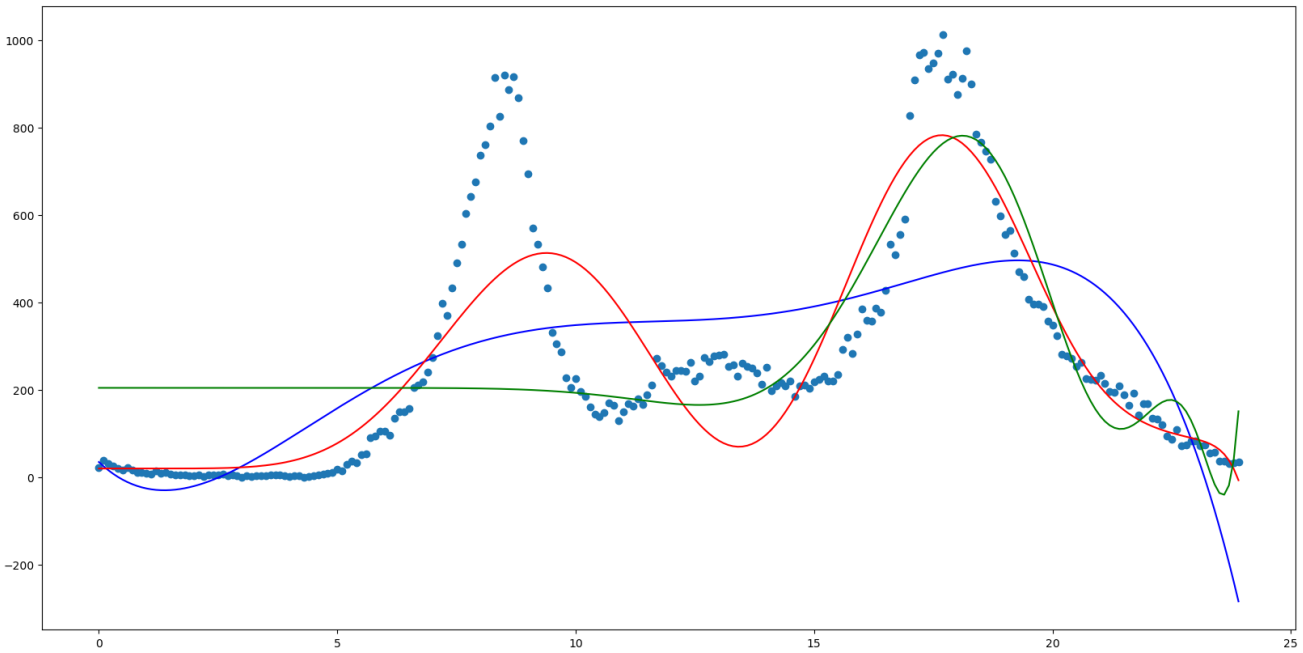
In [210…
```
mon_y = monday["monday"].values

mon_5 = poly5.fit_transform(monday["hour"].values.reshape(-1,1))
mon_15 = poly15.fit_transform(monday["hour"].values.reshape(-1,1))
mon_20 = poly20.fit_transform(monday["hour"].values.reshape(-1,1))
```

In [211…
```
mon5_linear = linear_model.LinearRegression()
mon5_linear.fit(mon_5, mon_y)
(mon5_linear.coef_, mon5_linear.intercept_)

mon15_linear = linear_model.LinearRegression()
mon15_linear.fit(mon_15, mon_y)
(mon15_linear.coef_, mon15_linear.intercept_)

mon20_linear = linear_model.LinearRegression()
mon20_linear.fit(mon_20, mon_y)
(mon20_linear.coef_, mon20_linear.intercept_)
```

Out[211]:
```
(array([ 0.00000000e+00, -7.60005861e-15, -5.37605225e-18,  1.28322334e-19,
        -6.08160851e-21, -7.15487169e-20, -7.82024458e-19, -8.17907992e-18,
        -8.11179617e-17, -7.52137094e-16, -6.38242518e-15, -4.79487842e-14,
        -3.01538420e-13, -1.42252461e-12, -3.75587593e-12,  9.95941334e-13,
        -1.00452548e-13,  4.97175776e-15, -1.21685928e-16,  1.18526905e-18,
        -1.10957723e-22]),
 204.00693152844906)
```

In [212…
```
plt.scatter(monday["hour"], monday["monday"])
plt.plot(monday["hour"].values, mon5_linear.predict(mon_5), c='b')
plt.plot(monday["hour"].values, mon15_linear.predict(mon_15), c='r')
plt.plot(monday["hour"].values, mon20_linear.predict(mon_20), c='g')
```

Out[212]:
```
[<matplotlib.lines.Line2D at 0x1d9321848e0>]
```



2b. Repeat `2a` for `saturday`

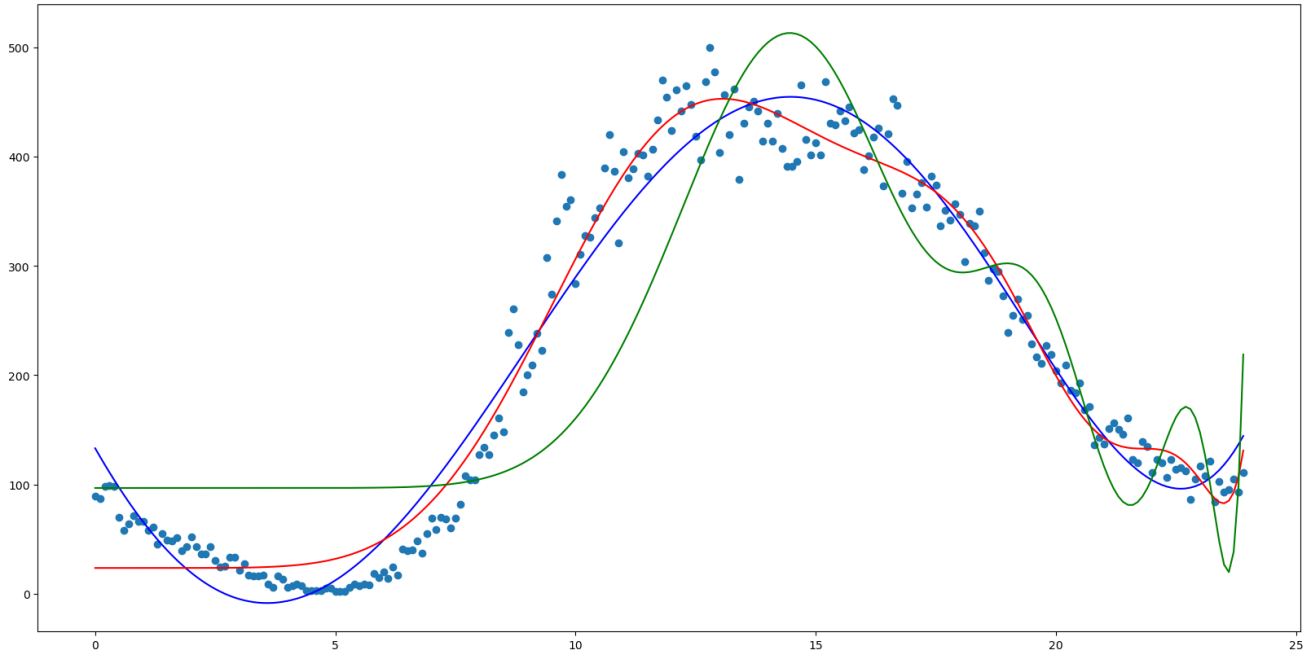
In [213…
```
sat_y = saturday["saturday"].values

sat_5 = poly5.fit_transform(saturday["hour"].values.reshape(-1,1))
sat_15 = poly15.fit_transform(saturday["hour"].values.reshape(-1,1))
sat_20 = poly20.fit_transform(saturday["hour"].values.reshape(-1,1))
```

In [214…
```
sat5_linear = linear_model.LinearRegression()
sat5_linear.fit(sat_5, sat_y)
(sat5_linear.coef_, sat5_linear.intercept_)

sat15_linear = linear_model.LinearRegression()
sat15_linear.fit(sat_15, sat_y)
(sat15_linear.coef_, sat15_linear.intercept_)

sat20_linear = linear_model.LinearRegression()
sat20_linear.fit(sat_20, sat_y)
(sat20_linear.coef_, sat20_linear.intercept_)
```

Out[214]:
```
(array([ 0.00000000e+00,  5.97741037e-14,  4.24197896e-17, -1.00946803e-18,
         4.78021581e-20,  5.62347279e-19,  6.14560305e-18,  6.42651223e-17,
         6.37226138e-16,  5.90673614e-15,  5.01025093e-14,  3.76170801e-13,
         2.36321538e-12,  1.11253461e-11,  2.91818709e-11, -9.00279962e-12,
         1.10626138e-12, -7.16110784e-14,  2.59156990e-15, -4.98138427e-17,
         3.97643442e-19]),
 96.67782335281373)
```

In [215…
```
plt.scatter(saturday["hour"], saturday["saturday"])
plt.plot(saturday["hour"].values, sat5_linear.predict(sat_5), c='b')
plt.plot(saturday["hour"].values, sat15_linear.predict(sat_15), c='r')
plt.plot(saturday["hour"].values, sat20_linear.predict(sat_20), c='g')
```

Out[215]:
```
[<matplotlib.lines.Line2D at 0x1d932200e50>]
```

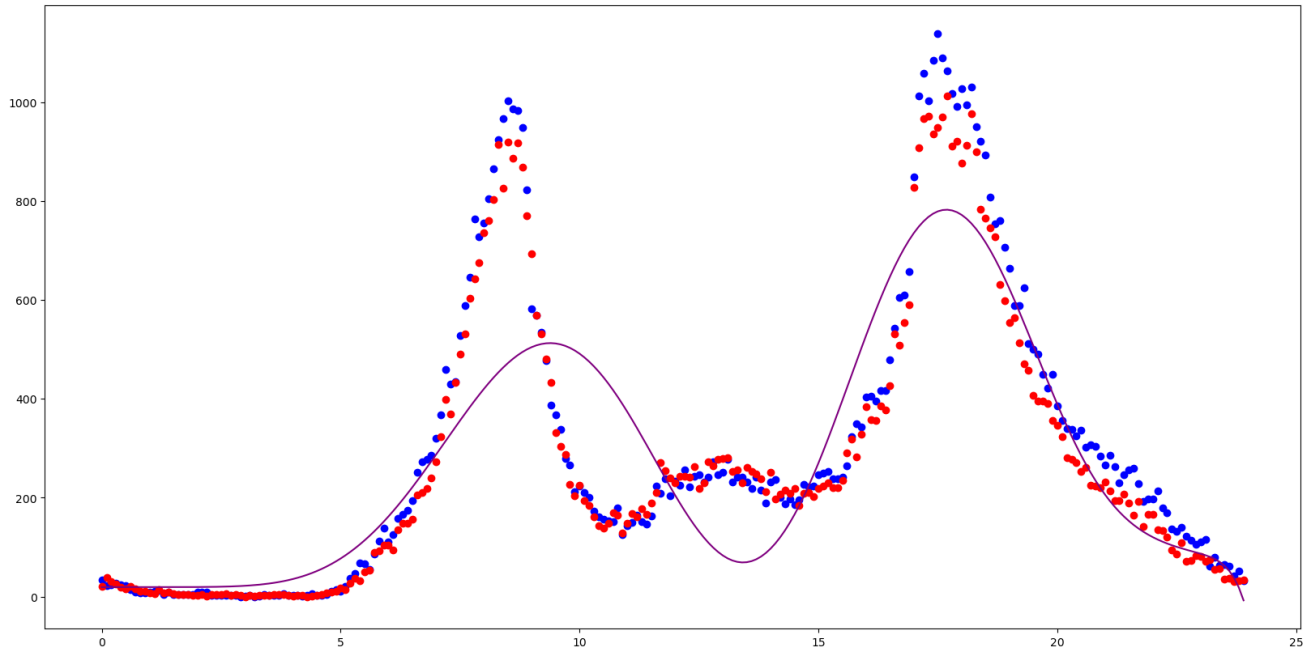


3. Using the best `monday` model's prediction, determine the errors (MSE, MAE, MAPE) between the prediction with the `monday` and `tuesday` datasets

Repeat for `saturday` / `sunday`

In [216…
```
plt.scatter(tuesday["hour"], tuesday["tuesday"], c='b')
plt.scatter(monday["hour"], monday["monday"], c='r')
plt.plot(tuesday["hour"].values, mon15_linear.predict(mon_15), c='purple')
```

Out[216]:
```
[<matplotlib.lines.Line2D at 0x1d932280850>]
```



In [217…
```
#Monday
(
    metrics.mean_squared_error(mon_y, mon15_linear.predict(mon_15)),
    metrics.mean_absolute_error(mon_y, mon15_linear.predict(mon_15)),
    metrics.mean_absolute_percentage_error(mon_y, mon15_linear.predict(mon_15))
)
### that's a pretty crazy error right there :p probably fair to say our best model here still isn't a good model
```

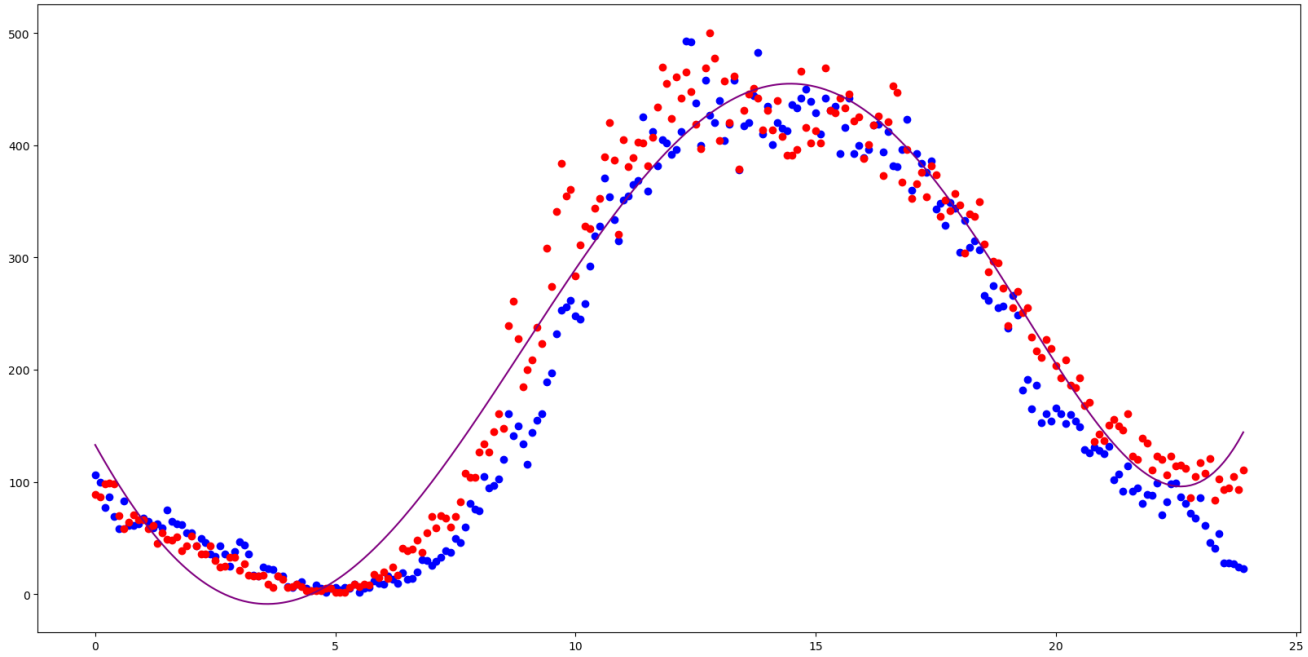
Out[217]:
```
(19252.717262616054, 97.43996817297307, 1246240782405456.5)
```

In [218…
```
#Tuesday (with Monday-trained model)
tue_y = tuesday["tuesday"].values
(
    metrics.mean_squared_error(tue_y, mon15_linear.predict(mon_15)),
    metrics.mean_absolute_error(tue_y, mon15_linear.predict(mon_15)),
    metrics.mean_absolute_percentage_error(tue_y, mon15_linear.predict(mon_15))
)
```

Out[218]:
```
(23675.012546937018, 105.10936241856159, 843959696017067.6)
```

In [219…
```
plt.scatter(sunday["hour"], sunday["sunday"], c='b')
plt.scatter(saturday["hour"], saturday["saturday"], c='r')
plt.plot(sunday["hour"].values, sat5_linear.predict(sat_5), c='purple')
```

Out[219]:
```
[<matplotlib.lines.Line2D at 0x1d9371af3a0>]
```



In [220…
```
#Saturday
(
    metrics.mean_squared_error(sat_y, sat5_linear.predict(sat_5)),
    metrics.mean_absolute_error(sat_y, sat5_linear.predict(sat_5)),
    metrics.mean_absolute_percentage_error(sat_y, sat5_linear.predict(sat_5))
)
```

Out[220]:
```
(995.216704817103, 25.34716980052032, 0.4698986726675889)
```

In [221…
```
#Sunday (with Saturday-trained model)
sun_y = sunday["sunday"].values
(
    metrics.mean_squared_error(sun_y, sat5_linear.predict(sat_5)),
    metrics.mean_absolute_error(sun_y, sat5_linear.predict(sat_5)),
    metrics.mean_absolute_percentage_error(sun_y, sat5_linear.predict(sat_5))
)
```

Out[221]:
```
(1751.9785640598352, 33.09179943380377, 0.7723154684687809)
```

4. With `saturday`, use `train_test_split` to create training and test sets and build a model. Create predictions using the xtest from and determine the errors between these predictions and the ytest (MSE, MAE, MAPE).

In [282…
```
from sklearn.model_selection import train_test_split
(satx_train, satx_test, saty_train, saty_test) = train_test_split(saturday["hour"].values, sat_y, test_size=.2)
```

In [283…
```
satx5_train = poly5.fit_transform(satx_train.reshape(-1,1))
satx5_test = poly5.fit_transform(satx_test.reshape(-1,1))
```

In [284…
```
sattest_linear = linear_model.LinearRegression()
sattest_linear.fit(satx5_train, saty_train)
(sattest_linear.coef_, sattest_linear.intercept_)
```

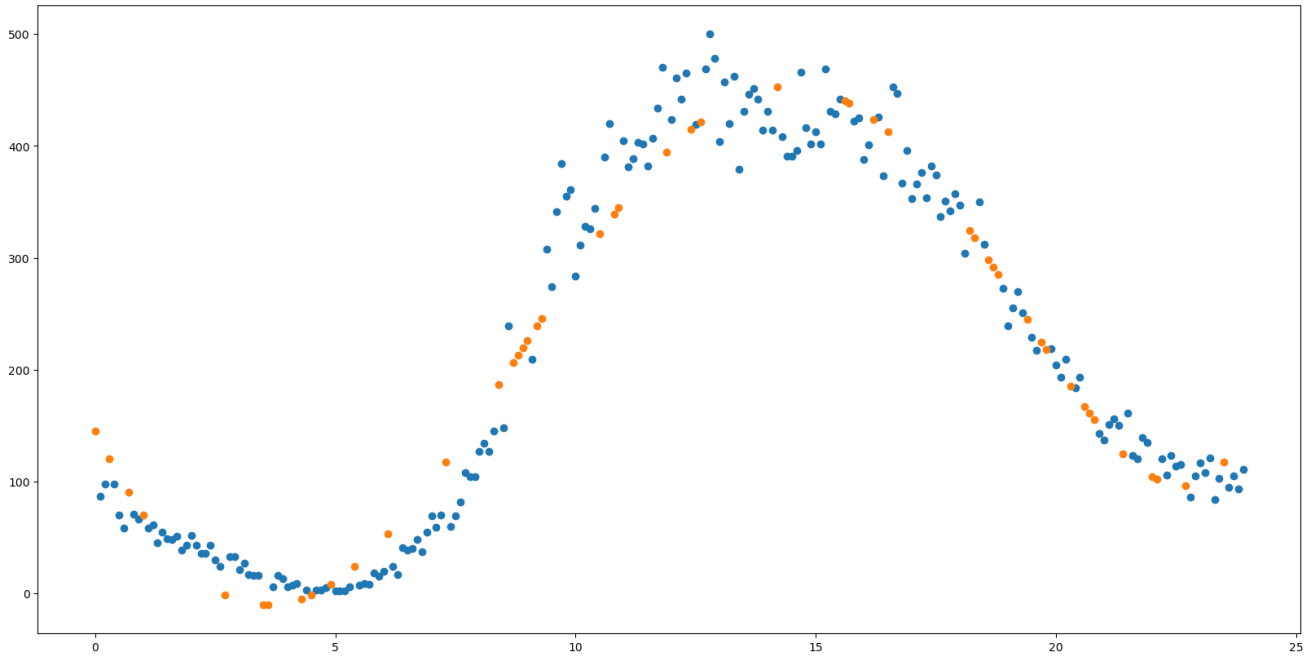
Out[284]:
```
(array([ 0.00000000e+00, -8.61731842e+01,  1.09499946e+01,  5.55267258e-01,
        -8.44912395e-02,  2.02483195e-03]),
 144.95664222746427)
```

In [286…
```
(
    metrics.mean_squared_error(saty_test, sattest_linear.predict(satx5_test)),
    metrics.mean_absolute_error(saty_test, sattest_linear.predict(satx5_test)),
    metrics.mean_absolute_percentage_error(saty_test, sattest_linear.predict(satx5_test))
)
```

Out[286]:
```
(620.0548472429537, 20.013210301540102, 0.37238040843347847)
```

In [285…
```
plt.scatter(satx_train, saty_train)
plt.scatter(satx_test, sattest_linear.predict(satx5_test))
```

Out[285]:
```
<matplotlib.collections.PathCollection at 0x1d935680340>
```



repeat for `monday`

In [287…
```
(monx_train, monx_test, mony_train, mony_test) = train_test_split(monday["hour"].values, mon_y, test_size=.2)
```

In [288…
```
monx15_train = poly15.fit_transform(monx_train.reshape(-1,1))
monx15_test = poly15.fit_transform(monx_test.reshape(-1,1))
```

In [289…
```
montest_linear = linear_model.LinearRegression()
montest_linear.fit(monx15_train, mony_train)
(montest_linear.coef_, montest_linear.intercept_)
```

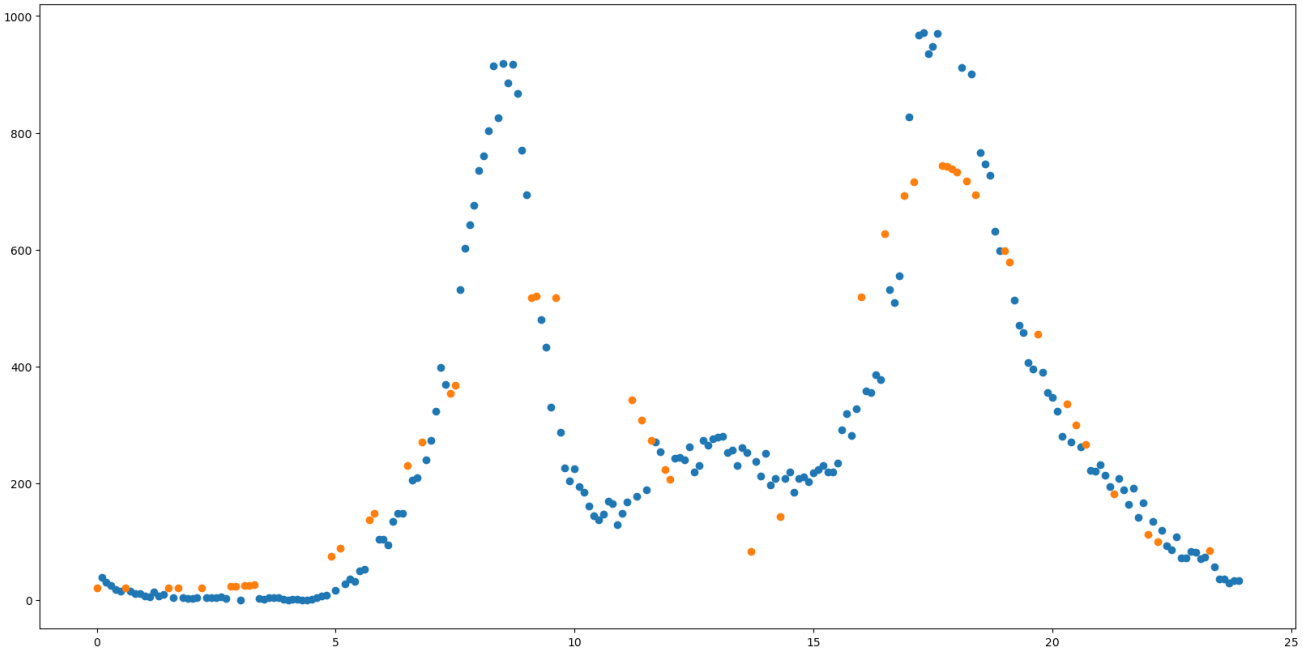
Out[289]:
```
(array([ 0.00000000e+00, -9.59175805e-06,  8.71267191e-08,  9.70911095e-07,
         6.16970295e-06,  3.43806886e-05,  1.59547681e-04,  5.50076614e-04,
         1.02324167e-03, -4.24920582e-04,  6.92646573e-05, -6.10166876e-06,
         3.17477324e-07, -9.80005784e-09,  1.66559829e-10, -1.20410247e-12]),
 21.522366762161255)
```

In [290…
```
(
    metrics.mean_squared_error(mony_test, montest_linear.predict(monx15_test)),
    metrics.mean_absolute_error(mony_test, montest_linear.predict(monx15_test)),
    metrics.mean_absolute_percentage_error(mony_test, montest_linear.predict(monx15_test))
)
```

Out[290]:
```
(11248.909429932273, 79.41650765002639, 2.2524298033865153)
```

In [291…
```
plt.scatter(monx_train, mony_train)
plt.scatter(monx_test, montest_linear.predict(monx15_test))
```

Out[291]:
```
<matplotlib.collections.PathCollection at 0x1d9356ddd00>
```


1000
800
600
400
200
0
0
5
10
15
20
25