We read in the data

In [1]:

```
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[1]:

	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

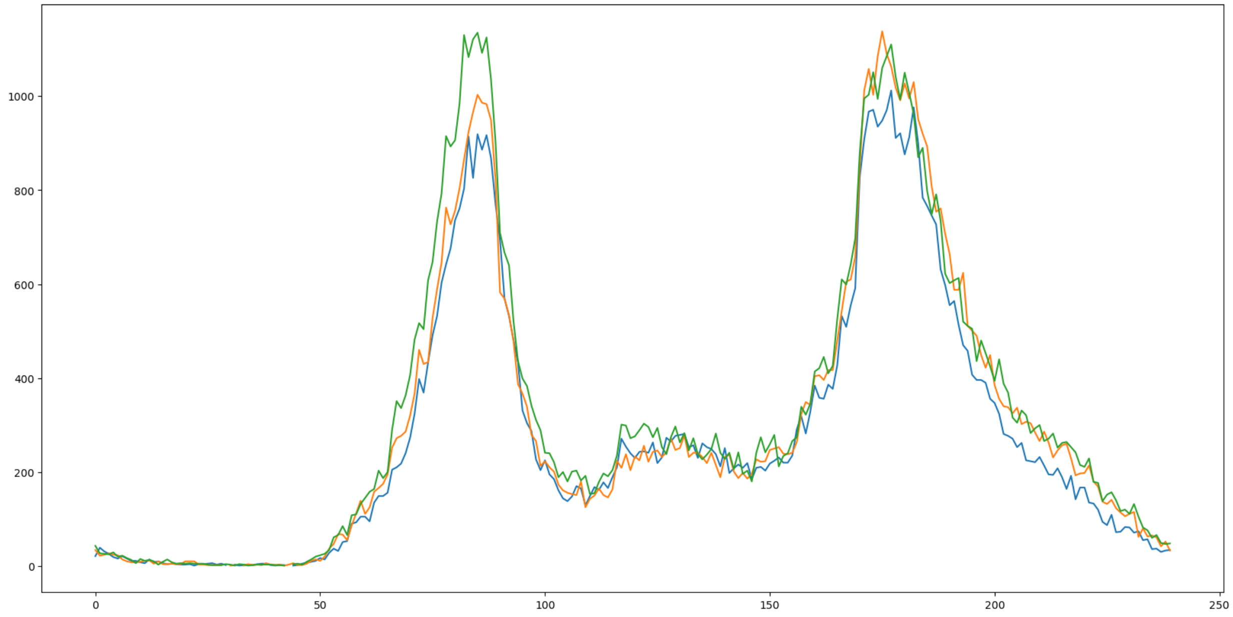
240 rows × 8 columns

In [2]:

```
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"])
```

Out[2]:

```
[<matplotlib.lines.Line2D at 0x29a14f83fd0>]
```



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 [3]: monday = day_hour_count[["hour","monday"]].copy()
```

```
In [4]: monday
```

Out[4]:

	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 [8]:

```
tuesday = day_hour_count[["hour","tuesday"]].copy()
saturday = day_hour_count[["hour","saturday"]].copy()
sunday = day_hour_count[["hour","sunday"]].copy()
tuesday
```

Out[8]:

	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 [6]:

```
saturday
```

```
Out[6]:
        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 [7]: sunday
```

```
Out[7]:
        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)

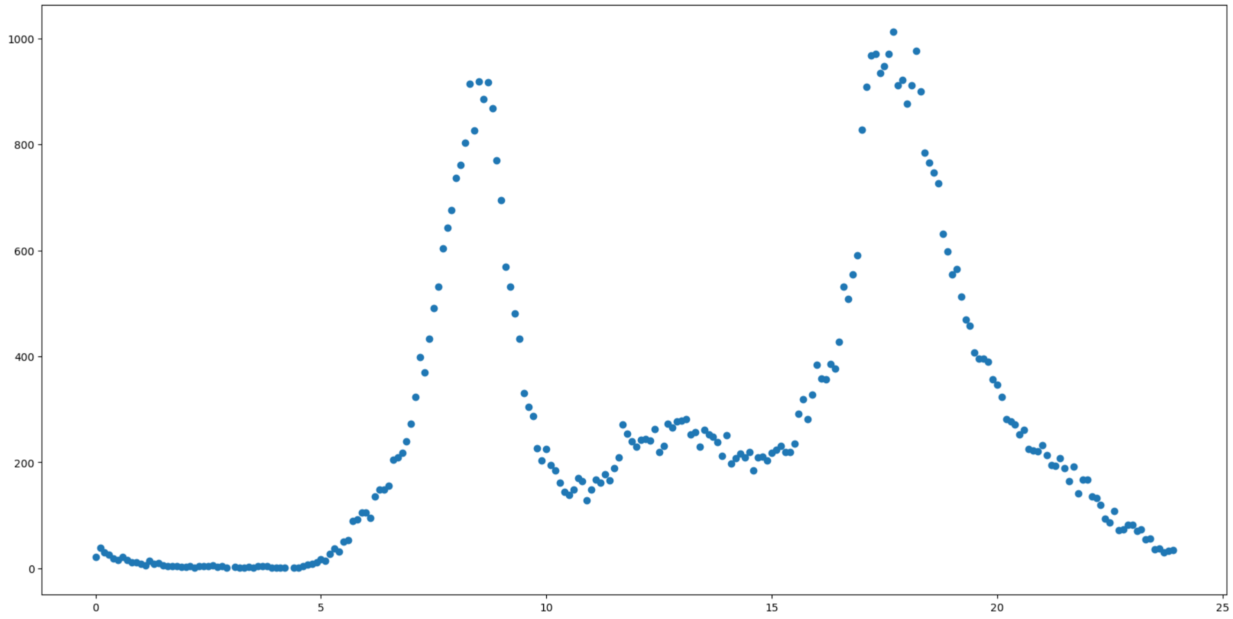
Plot all the results for each polynomial.

In [9]:

```
from sklearn import linear_model, metrics
linear = linear_model.LinearRegression()


monday["hour"]
plt.scatter(monday["hour"],monday["monday"])
#plt.scatter(tuesday["hour"],tuesday["tuesday"])
#plt.scatter(saturday["hour"],saturday["saturday"])
#plt.scatter(sunday["hour"],sunday["sunday"])
```

Out[9]:

```
<matplotlib.collections.PathCollection at 0x29a1868bf70>
```



In [10]:

```
from sklearn.preprocessing import PolynomialFeatures

x = monday['hour']
y = monday['monday']

x = np.asarray(x)
y = np.asarray(y)

x = x.reshape(-1,1)
y = y.reshape(-1,1)

x = np.nan_to_num(x, nan=0.0) # A NaN is throwing off my models
y = np.nan_to_num(y, nan=0.0)

# x_2 = PolynomialFeatures(degree=2).fit_transform(x)
# linear2 = linear_model.LinearRegression().fit(x, y)

#plt.plot(x, linear2.predict(x_2), c='r')
# plt.plot(x, linear10.predict(x), c='b')
#plt.plot(x, linear.predict(x), c='g')
```

In [11]:

```
# Linear
linear = linear_model.LinearRegression()

# x ^ 10 Polynomial
linear.fit(x,y)
```

```
poly = PolynomialFeatures(degree=10)
x_10 = poly.fit_transform(x)

linear10_monday = linear_model.LinearRegression()
linear10_monday.fit(x_10, y)
(linear10_monday.coef_, linear.intercept_)

# x ^ 5 Polynomial
poly = PolynomialFeatures(degree=5)
x_5 = poly.fit_transform(x)

linear5_monday = linear_model.LinearRegression()
linear5_monday.fit(x_5, y)
(linear5_monday.coef_, linear.intercept_)

# x ^ 20 Polynomial
poly = PolynomialFeatures(degree=20)
x_20 = poly.fit_transform(x)

linear20_monday = linear_model.LinearRegression()
linear20_monday.fit(x_20, y)
(linear20_monday.coef_, linear.intercept_)
```

Out[11]:

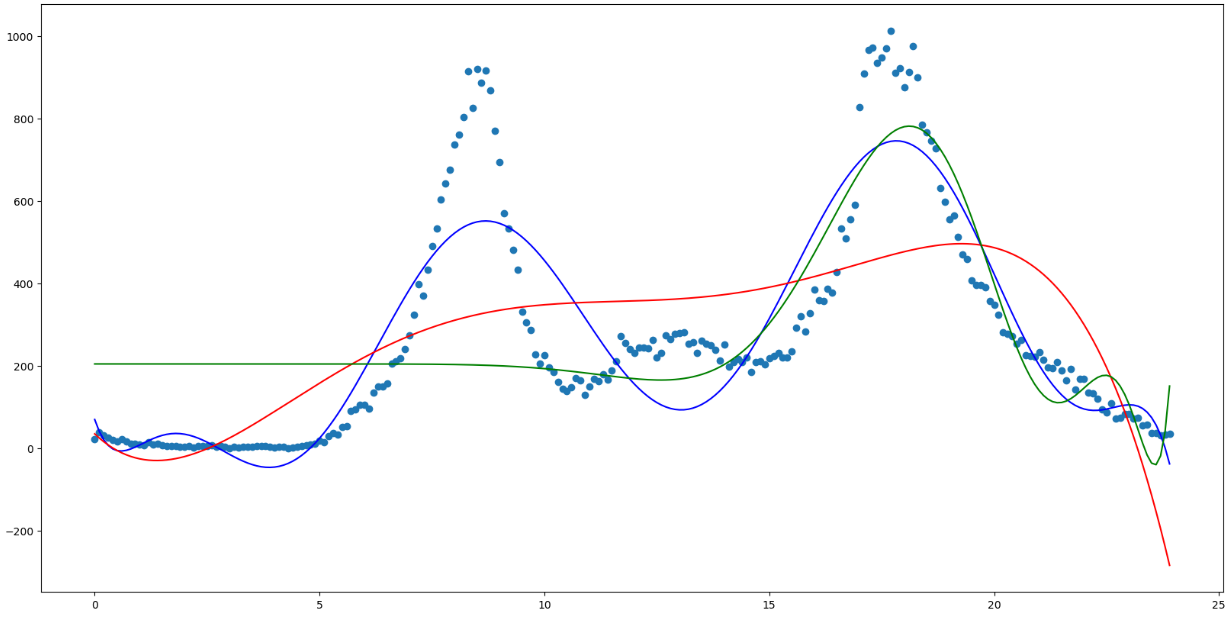
```
(array([[ 0.00000000e+00, -1.52574318e-14, -1.56457436e-17,
         -1.73129619e-20, -6.49100390e-21, -7.15213475e-20,
         -7.81743124e-19, -8.17612543e-18, -8.10885705e-17,
         -7.51863960e-16, -6.38010372e-15, -4.79313269e-14,
         -3.01428617e-13, -1.42200732e-12, -3.75451987e-12,
          9.95507740e-13, -1.00397587e-13,  4.96809904e-15,
         -1.21550106e-16,  1.18259680e-18, -8.91647308e-23]]),
 array([114.23817427]))
```

In [12]:

```
# Plotting all Models
plt.scatter(x,y)
plt.plot(x, linear10_monday.predict(x_10), c='b')
plt.plot(x, linear5_monday.predict(x_5), c='r')
plt.plot(x, linear20_monday.predict(x_20), c='g')
```

Out[12]:

```
[<matplotlib.lines.Line2D at 0x29a18f52230>]
```



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

In [13]:

```
# Updating x & y for 'saturday and repeating the code below:
x = saturday['hour']
y = saturday['saturday']

x = np.asarray(x)
y = np.asarray(y)

x = x.reshape(-1,1)
y = y.reshape(-1,1)

x = np.nan_to_num(x, nan=0.0) # A NaN is throwing off my models
y = np.nan_to_num(y, nan=0.0)
```

In [14]:

```
# x ^ 10 Polynomial
linear.fit(x,y)

poly = PolynomialFeatures(degree=10)
x_10 = poly.fit_transform(x)

linear10_saturday = linear_model.LinearRegression()
linear10_saturday.fit(x_10, y)
(linear10_saturday.coef_, linear.intercept_)

# x ^ 5 Polynomial
poly = PolynomialFeatures(degree=5)
x_5 = poly.fit_transform(x)

linear5_saturday = linear_model.LinearRegression()
linear5_saturday.fit(x_5, y)
(linear5_saturday.coef_, linear.intercept_)

# x ^ 20 Polynomial
poly = PolynomialFeatures(degree=20)
x_20 = poly.fit_transform(x)

linear20_saturday = linear_model.LinearRegression()
linear20_saturday.fit(x_20, y)
(linear20_saturday.coef_, linear.intercept_)
```

Out[14]:

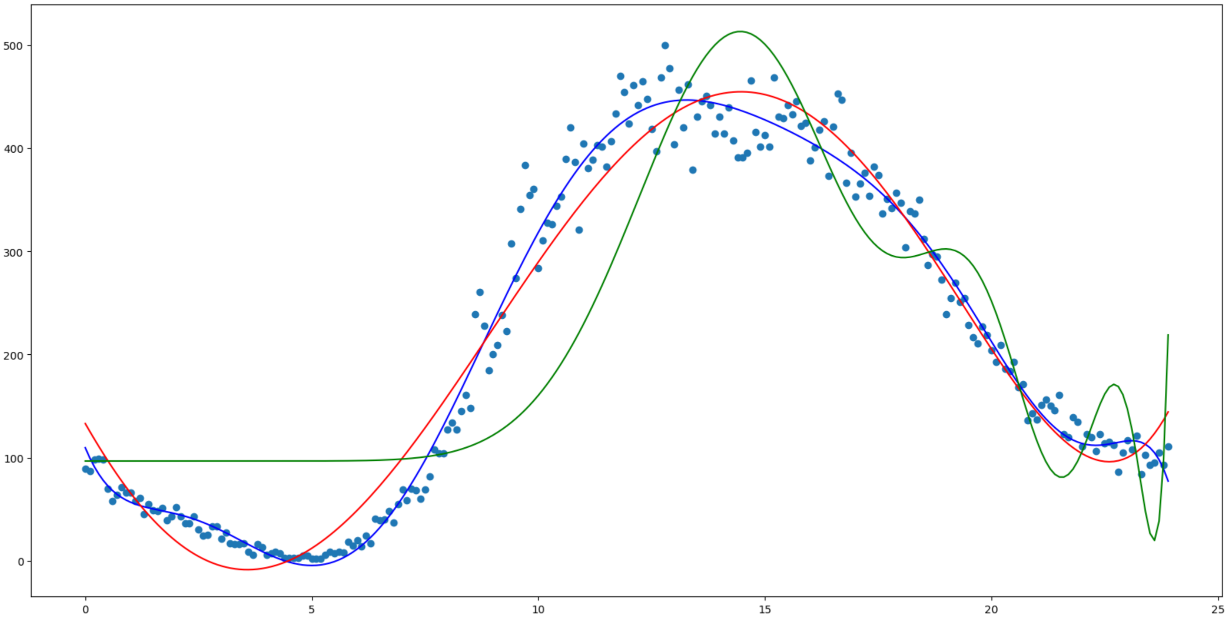
```
(array([[ 0.00000000e+00,  1.20021160e-13,  1.23109982e-16,
          1.36071800e-19,  5.10422186e-20,  5.62339868e-19,
          6.14566182e-18,  6.42656370e-17,  6.37230476e-16,
          5.90677072e-15,  5.01027639e-14,  3.76172473e-13,
          2.36322461e-12,  1.11253844e-11,  2.91819588e-11,
         -9.00283130e-12,  1.10626576e-12, -7.16113912e-14,
          2.59158221e-15, -4.98140970e-17,  3.97645605e-19]]),
 array([91.97282158]))
```

In [15]:

```
plt.scatter(x,y)
plt.plot(x, linear10_saturday.predict(x_10), c='b')
plt.plot(x, linear5_saturday.predict(x_5), c='r')
plt.plot(x, linear20_saturday.predict(x_20), c='g')
```

Out[15]:

```
[<matplotlib.lines.Line2D at 0x29a1873c4c0>]
```



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 [19]:
```
#Monday/Tuesday
# Monday 'y' Value
y = monday['monday']
y = np.asarray(y)
y = y.reshape(-1,1)
y = np.nan_to_num(y, nan=0.0)

# MSE
(
    metrics.mean_squared_error(y, linear5_monday.predict(x_5)),
    metrics.mean_squared_error(y, linear10_monday.predict(x_10)), # x^10 Polynomial se
    metrics.mean_squared_error(y, linear20_monday.predict(x_20))
)
```

Out[19]:
```
(41691.623119537966, 15797.94571296849, 38411.98741133111)
```

In [20]:
```
# MAE
(
    metrics.mean_absolute_error(y, linear5_monday.predict(x_5)),
    metrics.mean_absolute_error(y, linear10_monday.predict(x_10)),
    metrics.mean_absolute_error(y, linear20_monday.predict(x_20))
)
```

Out[20]:
```
(155.29586060280042, 95.4944071238648, 142.087052361142)
```

In [21]:
```
# MAPE
(
    metrics.mean_absolute_percentage_error(y, linear5_monday.predict(x_5)),
    metrics.mean_absolute_percentage_error(y, linear10_monday.predict(x_10)),
    metrics.mean_absolute_percentage_error(y, linear20_monday.predict(x_20))
)
```

Out[21]:

```
(2510747970908683.0, 996387484147850.5, 7656272697739356.0)
```

In [22]:

```
# Tuesday Results
# Tuesday 'y' Value
y = tuesday['tuesday']
y = np.asarray(y)
y = y.reshape(-1,1)
y = np.nan_to_num(y, nan=0.0)
```

In [23]:

```
# MSE
(
    metrics.mean_squared_error(y, linear5_monday.predict(x_5)),
    metrics.mean_squared_error(y, linear10_monday.predict(x_10)),
    metrics.mean_squared_error(y, linear20_monday.predict(x_20))
)
```

Out[23]:

```
(50934.14686789293, 19458.83509202751, 45184.0093751261)
```

In [24]:

```
# MAE
(
    metrics.mean_absolute_error(y, linear5_monday.predict(x_5)),
    metrics.mean_absolute_error(y, linear10_monday.predict(x_10)),
    metrics.mean_absolute_error(y, linear20_monday.predict(x_20))
)
```

Out[24]:

```
(160.60672891960334, 98.7838993534306, 148.6535765141456)
```

In [25]:

```
# MAPE
(
    metrics.mean_absolute_percentage_error(y, linear5_monday.predict(x_5)),
    metrics.mean_absolute_percentage_error(y, linear10_monday.predict(x_10)),
    metrics.mean_absolute_percentage_error(y, linear20_monday.predict(x_20))
)
```

Out[25]:

```
(1031934695490725.6, 685577805657012.9, 7656290675479110.0)
```

In [26]:

```
#Saturday/Sunday
y = saturday['saturday']
y = np.asarray(y)
y = y.reshape(-1,1)
y = np.nan_to_num(y, nan=0.0)

# MSE
(
    metrics.mean_squared_error(y, linear5_saturday.predict(x_5)),
    metrics.mean_squared_error(y, linear10_saturday.predict(x_10)),
    metrics.mean_squared_error(y, linear20_saturday.predict(x_20))
)
```

Out[26]:

```
(995.2167048171076, 475.432117731917, 6297.797133151873)
```

In [27]:

```
# MAE
(
    metrics.mean_absolute_error(y, linear5_saturday.predict(x_5)),
    metrics.mean_absolute_error(y, linear10_saturday.predict(x_10)),
    metrics.mean_absolute_error(y, linear20_saturday.predict(x_20))
)
```

Out[27]:

```
(25.347169800274006, 15.803728740895234, 65.02420578957252)
```

In [28]:

```
# MAPE
(
    metrics.mean_absolute_percentage_error(y, linear5_saturday.predict(x_5)),
    metrics.mean_absolute_percentage_error(y, linear10_saturday.predict(x_10)),
    metrics.mean_absolute_percentage_error(y, linear20_saturday.predict(x_20))
)
```

Out[28]:

```
(0.4698986726321545, 0.22012829723849595, 2.4338117469461764)
```

In [58]:

```
# Sunday Results
# Sunday 'y' Value
y = sunday['sunday']
y = np.asarray(y)
y = y.reshape(-1,1)
y = np.nan_to_num(y, nan=0.0)

# MSE
(
    metrics.mean_squared_error(y, linear5_saturday.predict(x_5)),
    metrics.mean_squared_error(y, linear10_saturday.predict(x_10)),
    metrics.mean_squared_error(y, linear20_saturday.predict(x_20))
)
```

Out[58]:

```
(1751.9785641232713, 1366.0930279055237, 4813.94395043641)
```

In [59]:

```
# MAE
(
    metrics.mean_absolute_error(y, linear5_saturday.predict(x_5)),
    metrics.mean_absolute_error(y, linear10_saturday.predict(x_10)),
    metrics.mean_absolute_error(y, linear20_saturday.predict(x_20))
)
```

Out[59]:

```
(33.09179943580984, 28.09846879707431, 59.146660667885165)
```

In [60]:

```
# MAPE
(
    metrics.mean_absolute_percentage_error(y, linear5_saturday.predict(x_5)),
    metrics.mean_absolute_percentage_error(y, linear10_saturday.predict(x_10)),
    metrics.mean_absolute_percentage_error(y, linear20_saturday.predict(x_20))
)
```

Out[60]:

```
(0.7723154684354743, 0.4082860111367491, 2.283873728034668)
```

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).

repeat for `monday`

In [64]:

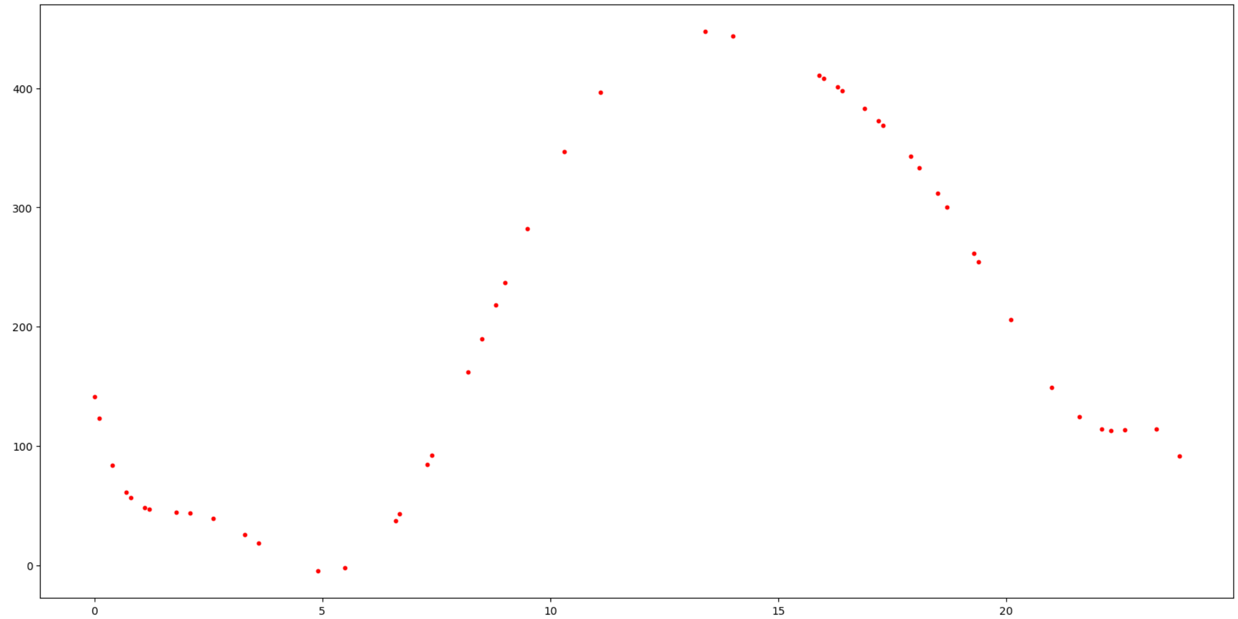
```
from sklearn.model_selection import train_test_split

#Saturday
# Updating x & y for 'saturday and repeating the code below:
x = saturday['hour']
y = saturday['saturday']

x = np.asarray(x)
y = np.asarray(y)

x = x.reshape(-1,1)
y = y.reshape(-1,1)

x = np.nan_to_num(x, nan=0.0) # A NaN is throwing off my models
y = np.nan_to_num(y, nan=0.0)

n = 100
xtrain, xtest, ytrain, ytest = train_test_split(x, y, test_size=0.2)

# linear = linear_model.LinearRegression().fit(xtrain, ytrain)

xtrain10_saturday = PolynomialFeatures(degree=10).fit_transform(xtrain)
xtest10_saturday = PolynomialFeatures(degree=10).fit_transform(xtest)
linear10_saturday = linear_model.LinearRegression().fit(xtrain10_saturday, ytrain)

xtrain15_saturday = PolynomialFeatures(degree=15).fit_transform(xtrain)
xtest15_saturday = PolynomialFeatures(degree=15).fit_transform(xtest)
linear15_saturday = linear_model.LinearRegression().fit(xtrain15_saturday, ytrain)
```

In [65]:

```
size = 10
plt.scatter(xtest, linear10_saturday.predict(xtest10_saturday), c='r', s=size)
```

Out[65]:

```
<matplotlib.collections.PathCollection at 0x29a1cb5d9f0>
```



In [66]:

```
(
    metrics.mean_squared_error(ytest, linear15_saturday.predict(xtest15)),
    metrics.mean_absolute_error(ytest, linear15_saturday.predict(xtest15)),
    metrics.mean_absolute_percentage_error(ytest, linear15_saturday.predict(xtest15))
)
```

Out[66]:

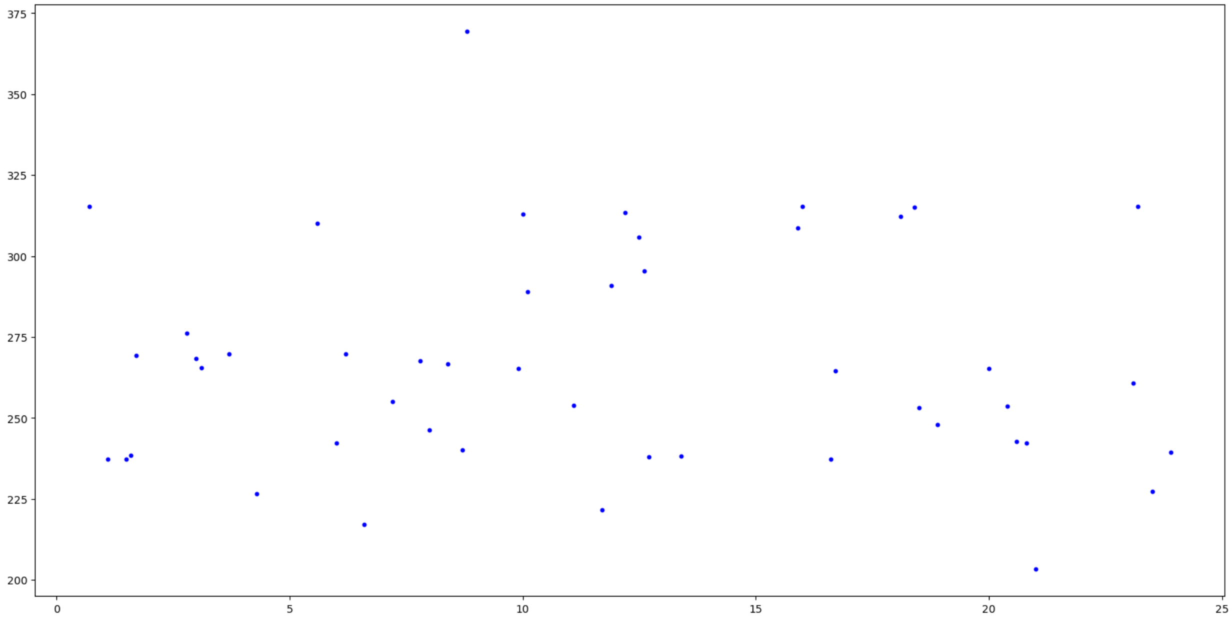
```
(50435.26774874914, 190.32527819285647, 2.7194204212694704)
```

In [67]:

```
from sklearn.model_selection import train_test_split

# Monday
# Updating x & y for 'saturday and repeating the code below:
x = monday['hour']
y = monday['monday']

x = np.asarray(x)
y = np.asarray(y)

x = x.reshape(-1,1)
y = y.reshape(-1,1)

x = np.nan_to_num(x, nan=0.0) # A NaN is throwing off my models
y = np.nan_to_num(y, nan=0.0)

n = 100
xtrain, xtest, ytrain, ytest = train_test_split(x, y, test_size=0.2)

# linear = linear_model.LinearRegression().fit(xtrain, ytrain)

# xtrain10 = PolynomialFeatures(degree=10).fit_transform(xtrain)
# xtest10 = PolynomialFeatures(degree=10).fit_transform(xtest)
# linear10 = linear_model.LinearRegression().fit(xtrain10, ytrain)

xtrain15_monday = PolynomialFeatures(degree=15).fit_transform(xtrain)
xtest15_monday = PolynomialFeatures(degree=15).fit_transform(xtest)
linear15_monday = linear_model.LinearRegression().fit(xtrain15, ytrain)
```

In [68]:
```
size = 10
plt.scatter(xtest, linear15_monday.predict(xtest15), c='b', s=size)
```

Out[68]:
```
<matplotlib.collections.PathCollection at 0x29a1cba8f40>
```



In [69]:
```
(
    metrics.mean_squared_error(ytest, linear15_monday.predict(xtest15)),
    metrics.mean_absolute_error(ytest, linear15_monday.predict(xtest15)),
    metrics.mean_absolute_percentage_error(ytest, linear15_monday.predict(xtest15))
)
```

Out[69]:
```
(73536.50396284113, 210.07066890545207, 4.6446889255946024e+16)
```