Linear Regression

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16BCE1259
Shushil Kumar Ravishankar

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sb

from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
```

In [2]:
```
df = pd.read_csv('clean_bmart.csv')
df.drop('Unnamed: 0', axis=1, inplace=True)
df.head()
```

Out[2]:

	Item_Identifier	Item_Weight	Item_Fat_Content	Item_Visibility	Item_Type	Item_MRP	Outlet_Identifier	Outlet_Establishment_Year	Outlet_Size	Outlet_Location_Type
0	FDA15	9.30	Low Fat	0.016047	Dairy	249.8092	OUT049	1999	Medium	Tier 1
1	DRC01	5.92	Regular	0.019278	Soft Drinks	48.2692	OUT018	2009	Medium	Tier 3
2	FDN15	17.50	Low Fat	0.016760	Meat	141.6180	OUT049	1999	Medium	Tier 1
3	FDX07	19.20	Regular	0.000000	Fruits and Vegetables	182.0950	OUT010	1998	Medium	Tier 3
4	NCD19	8.93	Low Fat	0.000000	Household	53.8614	OUT013	1987	High	Tier 3

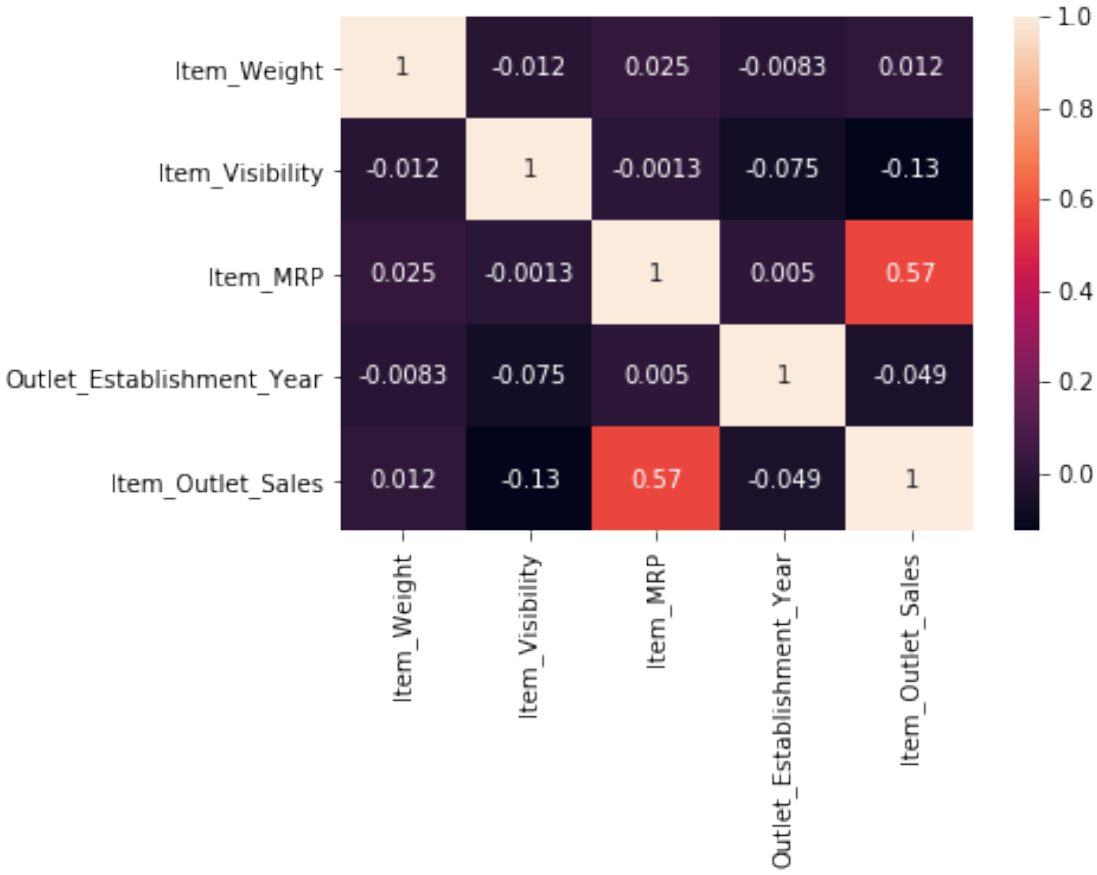
```
         Outlet_Type  Item_Outlet_Sales
0  Supermarket Type1          3735.1380
1  Supermarket Type2           443.4228
2  Supermarket Type1          2097.2700
3      Grocery Store           732.3800
4  Supermarket Type1           994.7052
```

In [3]:
```
corrmatrix = df.corr()
corrmatrix.head()
```

Out[3]:
```
                           Item_Weight  Item_Visibility  Item_MRP  \
Item_Weight                   1.000000        -0.012049  0.024756
Item_Visibility              -0.012049         1.000000 -0.001315
Item_MRP                      0.024756        -0.001315  1.000000
Outlet_Establishment_Year    -0.008301        -0.074834  0.005020
Item_Outlet_Sales             0.011550        -0.128625  0.567574

                           Outlet_Establishment_Year  Item_Outlet_Sales
Item_Weight                                -0.008301           0.011550
Item_Visibility                            -0.074834          -0.128625
Item_MRP                                    0.005020           0.567574
Outlet_Establishment_Year                   1.000000          -0.049135
Item_Outlet_Sales                          -0.049135           1.000000
```

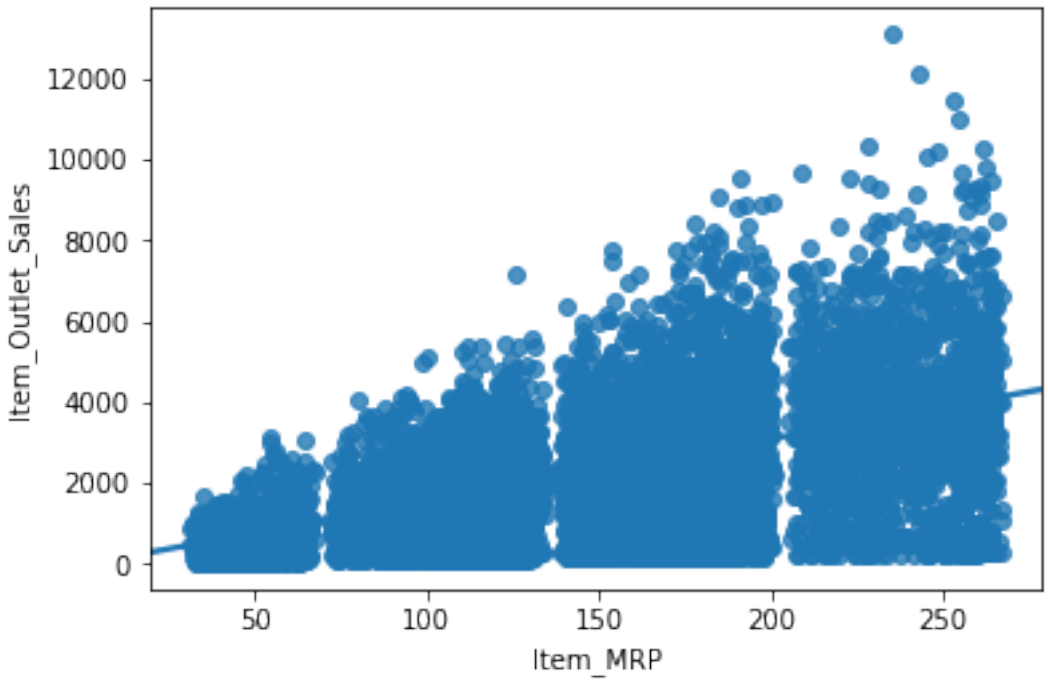
In [4]:
```
sb.heatmap(corrmatrix, annot=True)
```

Out[4]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x10aa50a20>
```



In [5]:
```
# We have maximum correlation between Height and and Weight attributes.
sb.regplot(data=df, x='Item_MRP', y='Item_Outlet_Sales')
```

Out[5]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x10af30748>
```

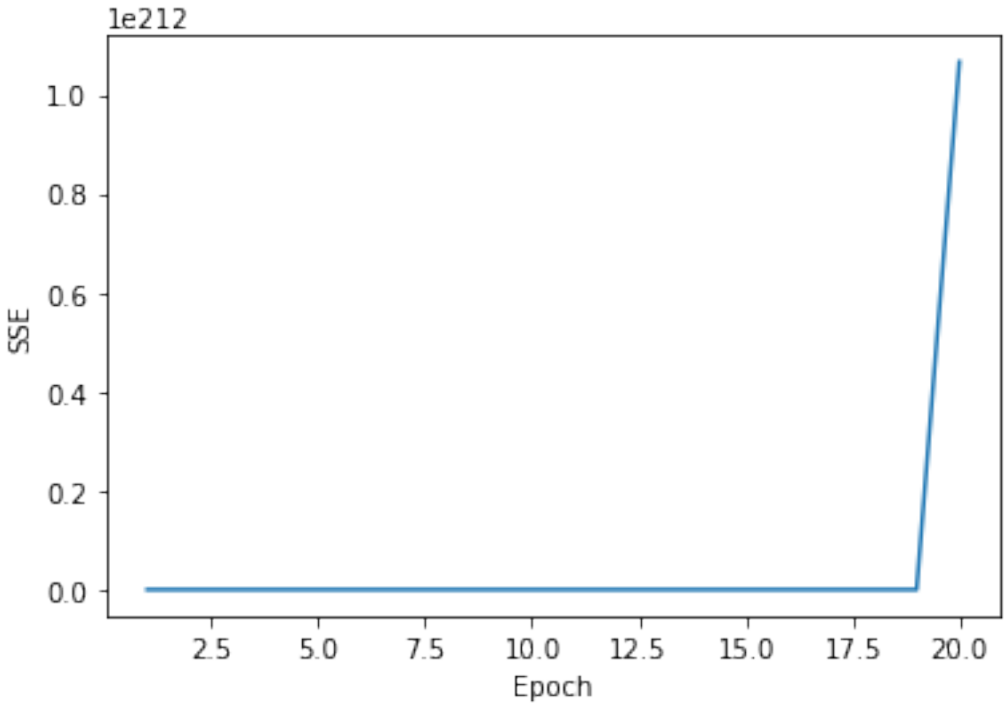


In [6]:
```
class LinearRegressionGD(object):

    def __init__(self, eta=0.001, n_iter=20):
        self.eta = eta
        self.n_iter = n_iter

    def fit(self, X, y):
        self.w_ = np.zeros(1 + X.shape[1])
        self.cost_ = []

        for i in range(self.n_iter):
            output = self.net_input(X)
            errors = (y - output)
            self.w_[1:] += self.eta * X.T.dot(errors)
            self.w_[0] += self.eta * errors.sum()
            cost = (errors**2).sum() / 2.0
            self.cost_.append(cost)
        return self

    def net_input(self, X):
        return np.dot(X, self.w_[1:]) + self.w_[0]

    def predict(self, X):
        return self.net_input(X)
```

In [7]:
```
x = df[['Item_MRP']].values
y = df['Item_Outlet_Sales'].values

xa_train, xa_test, ya_train, ya_test = train_test_split(x, y, test_size=0.3)

lreg = LinearRegressionGD()
lreg.fit(x, y)
```

Out[7]: <__main__.LinearRegressionGD at 0x10aa04b70>

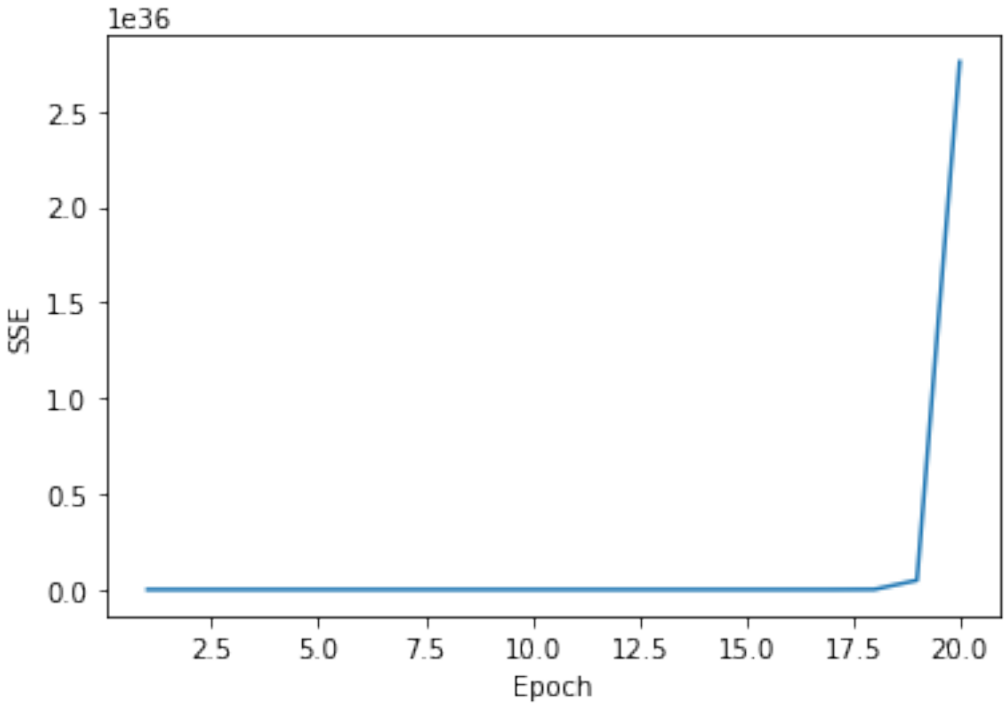
In [8]:
```
plt.plot(range(1, lreg.n_iter+1), lreg.cost_)
plt.ylabel('SSE')
plt.xlabel('Epoch')
plt.show()
```



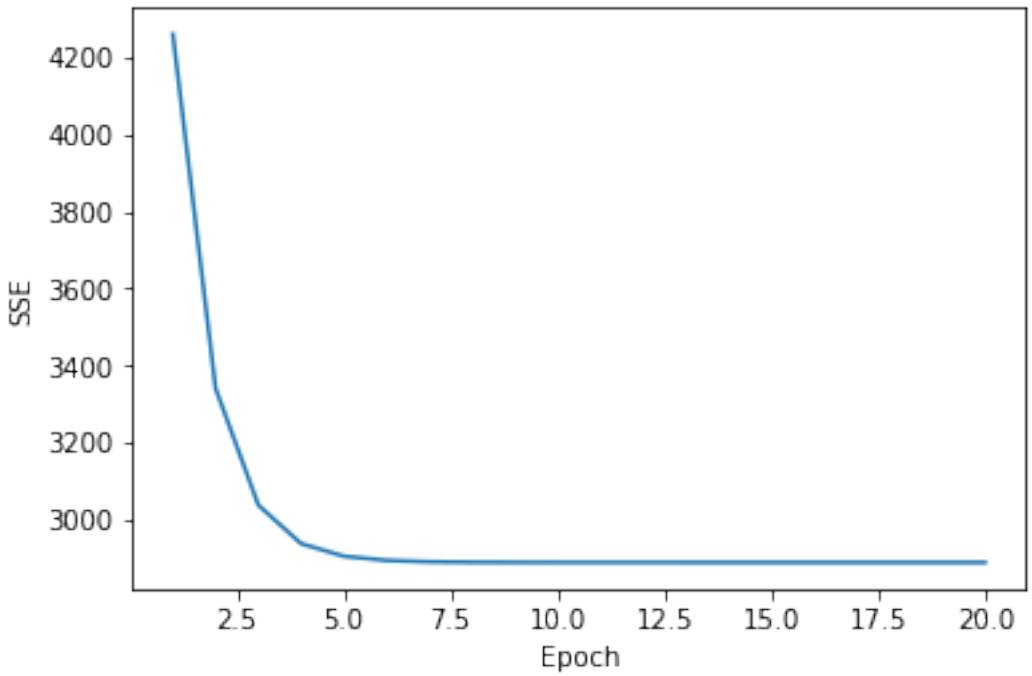
In [9]:
```
sc_x = StandardScaler()
sc_y = StandardScaler()
x_std = sc_x.fit_transform(x)
y_std = sc_y.fit_transform(y[:, np.newaxis]).flatten()

x_train, x_test, y_train, y_test = train_test_split(x_std, y_std, test_size=0.3)

lreg = LinearRegressionGD()
lreg.fit(x_std, y_std)
```

```
Out[9]: <__main__.LinearRegressionGD at 0x10afc0278>
```

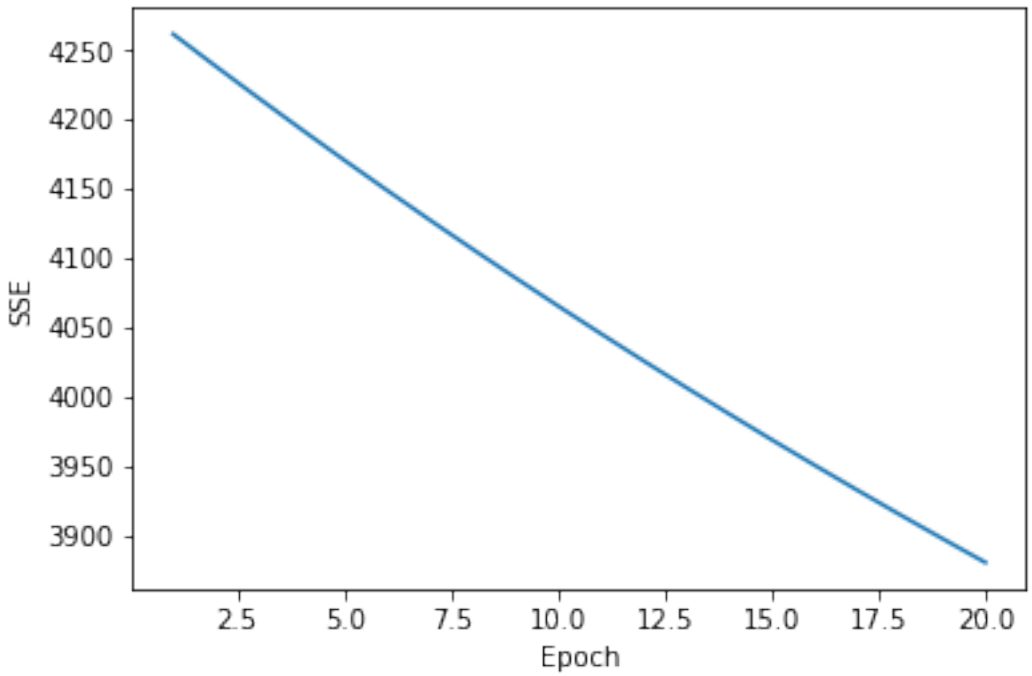
```
In [10]: plt.plot(range(1, lreg.n_iter+1), lreg.cost_)
         plt.ylabel('SSE')
         plt.xlabel('Epoch')
         plt.show()
```



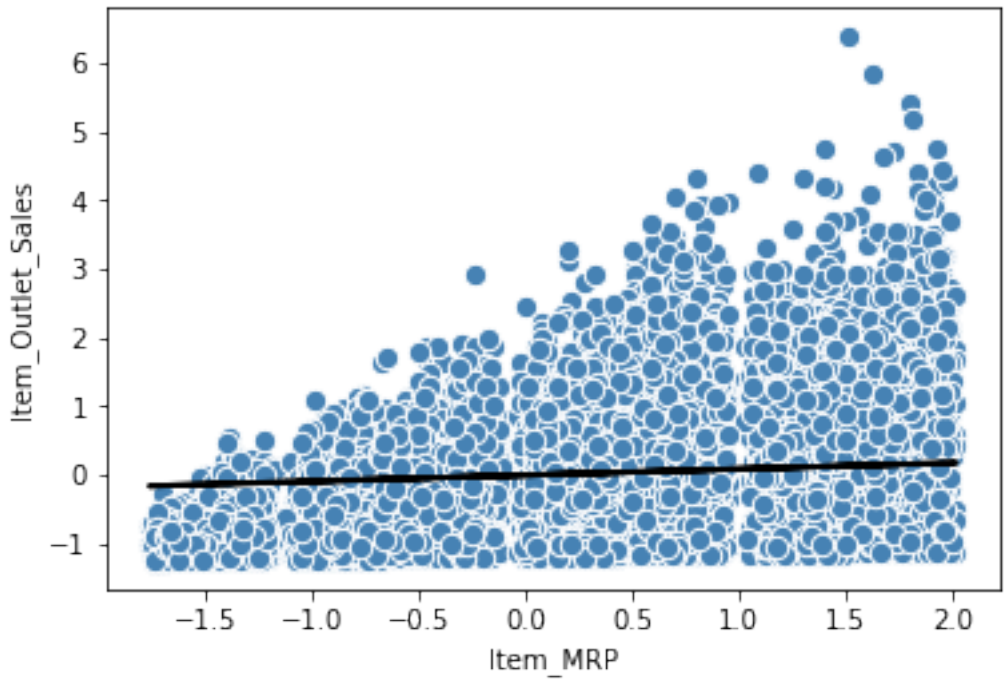

```
In [11]: lreg = LinearRegressionGD(eta=0.00005)
         lreg.fit(x_std, y_std)
         plt.plot(range(1, lreg.n_iter+1), lreg.cost_)
         plt.ylabel('SSE')
         plt.xlabel('Epoch')
         plt.show()
```



In [12]:
```
lreg = LinearRegressionGD(eta=0.000001)
lreg.fit(x_std, y_std)
plt.plot(range(1, lreg.n_iter+1), lreg.cost_)
plt.ylabel('SSE')
plt.xlabel('Epoch')
plt.show()
```



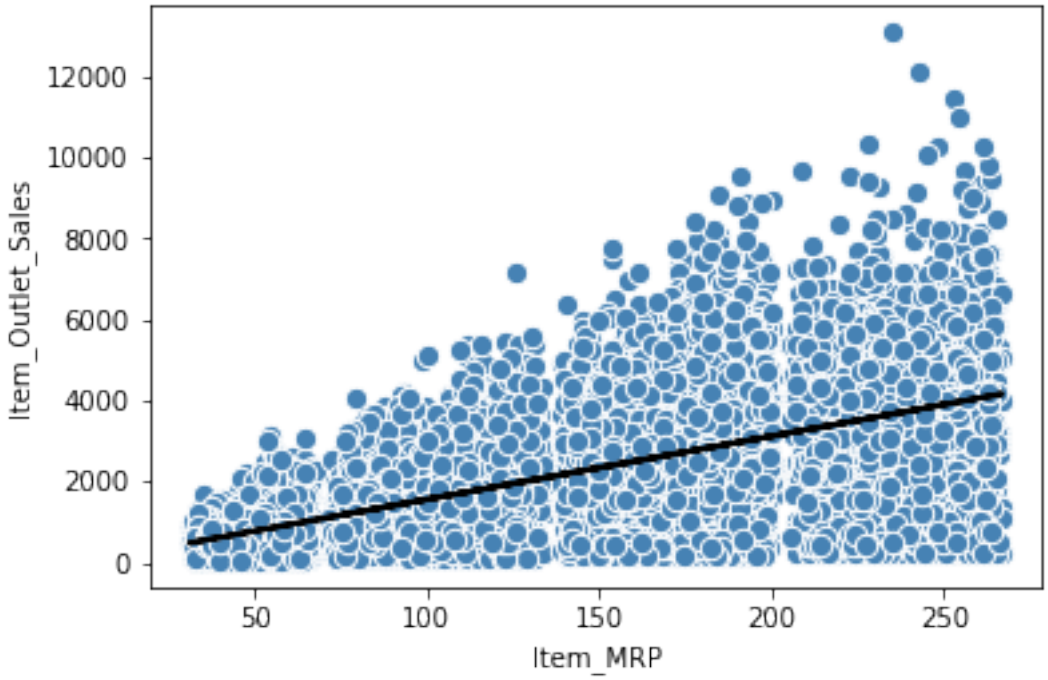

```
In [13]: def lin_regplot(X, y, model):
             plt.scatter(X, y, c='steelblue', edgecolor='white', s=70)
             plt.plot(X, model.predict(X), color='black', lw=2)
             return

In [14]: print('Slope: %.3f' % lreg.w_[1])
         print('Intercept: %.3f' % lreg.w_[0])

         lin_regplot(x_std, y_std, lreg)
         plt.xlabel('Item_MRP')
         plt.ylabel('Item_Outlet_Sales')
         plt.show()

Slope: 0.089
Intercept: 0.000
```



In [15]:
```
# Using sklearn

from sklearn.linear_model import LinearRegression

slr = LinearRegression()
slr.fit(xa_train, ya_train)
y_pred = slr.predict(x_test)
print('Slope: %.3f' % slr.coef_[0])
print('Intercept: %.3f' % slr.intercept_)

print('Accuracy: %.2f' % slr.score(xa_test, ya_test))

lin_regplot(x, y, slr)
plt.xlabel('Item_MRP')
plt.ylabel('Item_Outlet_Sales')
plt.show()
```

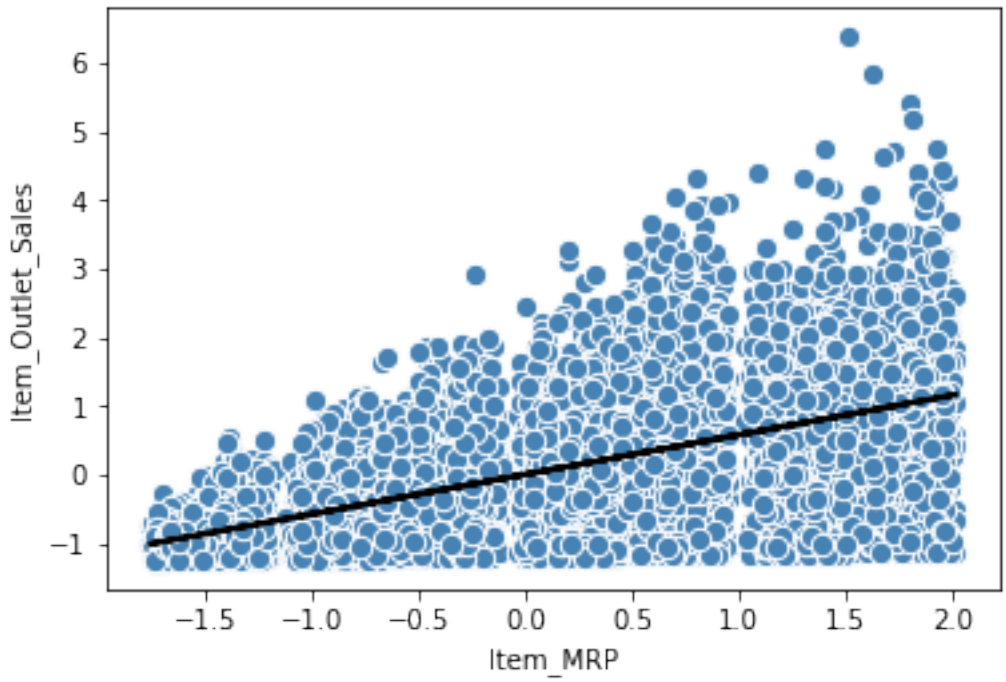
```
Slope: 15.625
Intercept: -9.847
Accuracy: 0.32
```

```
/Library/Frameworks/Python.framework/Versions/3.7/lib/python3.7/site-packages/sklearn/linear_mo
  linalg.lstsq(X, y)
```



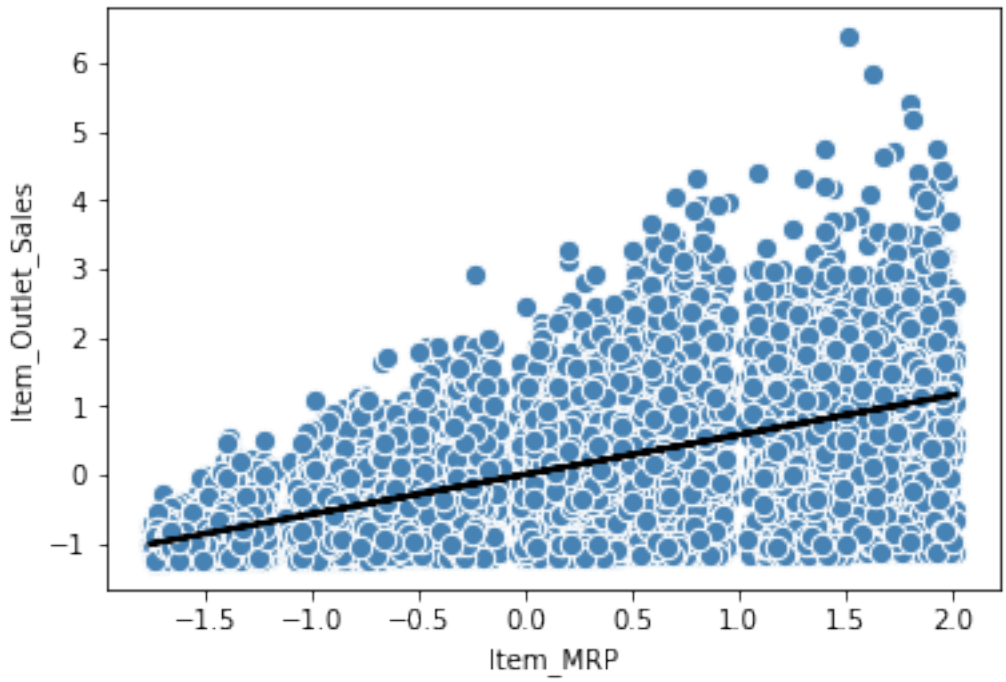

```
In [16]: slr = LinearRegression()
         slr.fit(x_train, y_train)
         y_pred = slr.predict(x_test)

         print('Slope: %.3f' % slr.coef_[0])
         print('Intercept: %.3f' % slr.intercept_)

         print('Accuracy: %.2f' % slr.score(x_test, y_test))

         lin_regplot(x_std, y_std, slr)
         plt.xlabel('Item_MRP')
         plt.ylabel('Item_Outlet_Sales')
         plt.show()
```

```
Slope: 0.575
Intercept: 0.010
Accuracy: 0.31
```



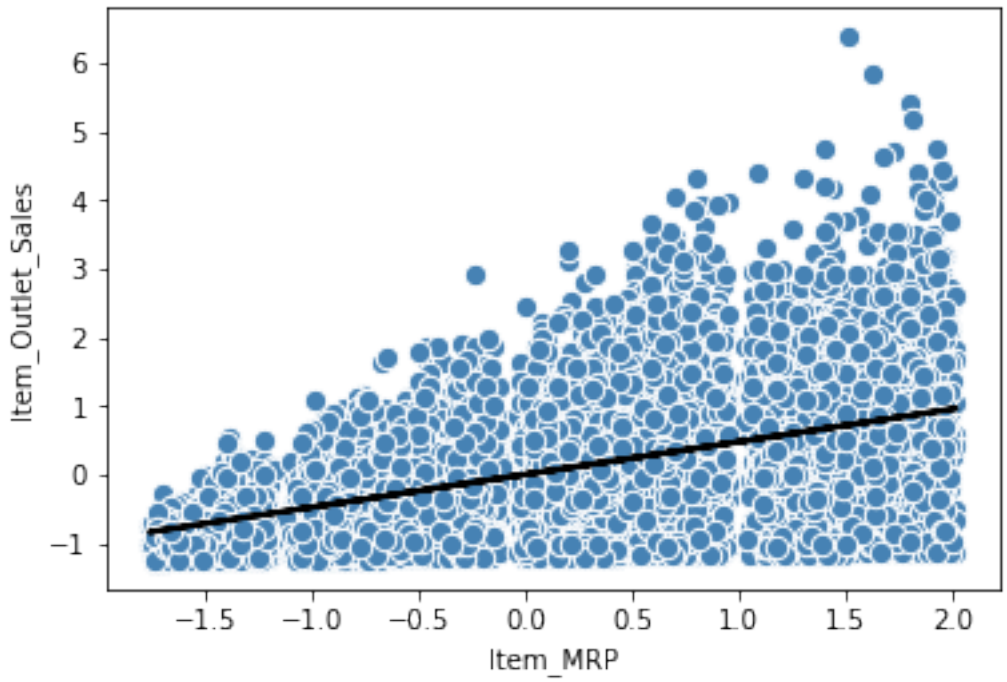
In [17]:
```
# Ridge regression

from sklearn.linear_model import Ridge

rdg = Ridge(alpha=0.1)
rdg.fit(x_train, y_train)
y_pred = rdg.predict(x_test)
print('Slope: %.3f' % rdg.coef_[0])
print('Intercept: %.3f' % rdg.intercept_)

print('Accuracy: %.2f' % rdg.score(x_test, y_test))

lin_regplot(x_std, y_std, rdg)
plt.xlabel('Item_MRP')
plt.ylabel('Item_Outlet_Sales')
plt.show()
```

```
Slope: 0.575
Intercept: 0.010
Accuracy: 0.31
```



In [18]:
```
# Lasso regression

from sklearn.linear_model import Lasso

las = Lasso(alpha=0.1)
las.fit(x_train, y_train)
y_pred = las.predict(x_test)

print('Slope: %.3f' % las.coef_[0])
print('Intercept: %.3f' % las.intercept_)

print('Accuracy: %.2f' % las.score(x_test, y_test))

lin_regplot(x_std, y_std, las)
plt.xlabel('Item_MRP')
plt.ylabel('Item_Outlet_Sales')
plt.show()
```

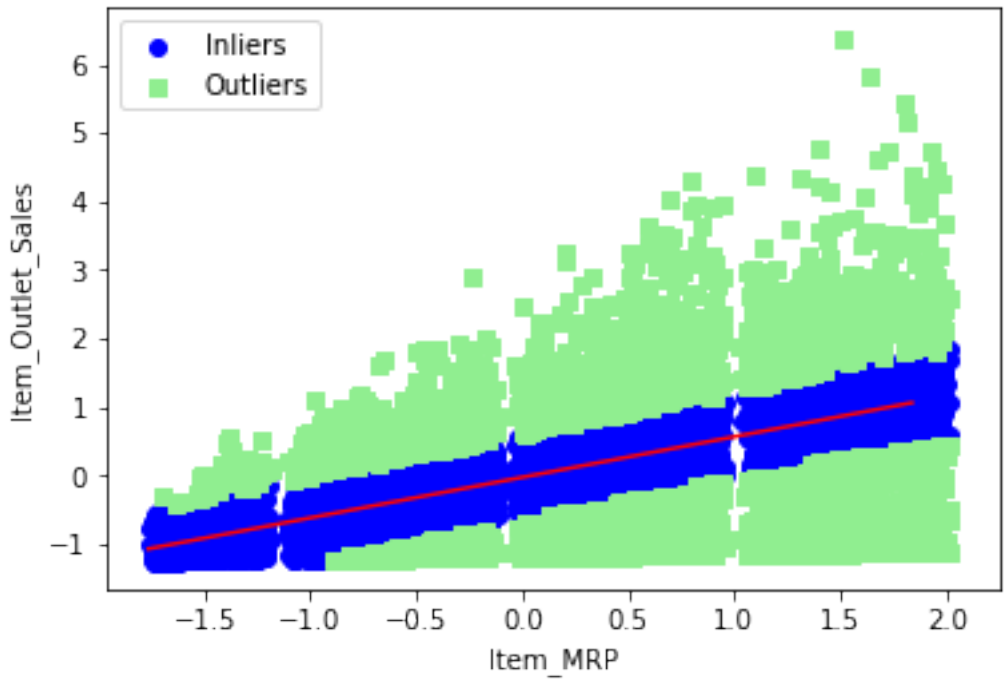
```
Slope: 0.475
Intercept: 0.009
Accuracy: 0.31
```




```
In [19]: from sklearn.linear_model import RANSACRegressor

         ransac = RANSACRegressor(LinearRegression(),
                                  max_trials=100,
                                  min_samples=50,)
         x, y = x_std, y_std
         ransac.fit(x,y)
```

```
Out[19]: RANSACRegressor(base_estimator=LinearRegression(copy_X=True, fit_intercept=True, n_jo
                is_data_valid=None, is_model_valid=None, loss='absolute_loss',
                max_skips=inf, max_trials=100, min_samples=50, random_state=None,
                residual_metric=None, residual_threshold=None, stop_n_inliers=inf,
                stop_probability=0.99, stop_score=inf)
```

```
In [20]: inlier_mask = ransac.inlier_mask_
         outlier_mask = np.logical_not(inlier_mask)
         line_X = np.arange(x.min(), x.max(),1.8)
         line_y_ransac = ransac.predict(line_X[:, np.newaxis])
         plt.scatter(x[inlier_mask], y[inlier_mask],c='blue', marker='o', label='Inliers')
         plt.scatter(x[outlier_mask], y[outlier_mask],c='lightgreen', marker='s', label='Outli
         plt.plot(line_X, line_y_ransac, color='red')
         plt.xlabel('Item_MRP')
         plt.ylabel('Item_Outlet_Sales')
         plt.legend(loc = 'upper left')
         plt.show()
```




```
In [21]: print('Slope: %.3f' % ransac.estimator_.coef_[0])
         print('Intercept: %.3f' % ransac.estimator_.intercept_)
         print('Score: %.3f' % ransac.score(x,y))
```

```
Slope: 0.592
Intercept: -0.025
Score: 0.321
```