Problem-2

January 24, 2023

1 2. Multivariate Regression

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

from GradientDescent import BatchGD
```

1.0.1 1. Read the excel file using pandas and perform data cleaning. Remove 1st column 'id' which may not be necessary here. Perform mean normalization of features.

[2]:
```
# Reading the file prob2data.csv using pandas
house_price  = pd.read_csv("data/prob2data.csv")
house_price.head()
```

[2]:

	id	price	bedrooms	bathrooms	sqft_living	floors	yr_built
0	7129300520	221900.0	3	1.00	1180	1.0	1955
1	6414100192	538000.0	3	2.25	2570	2.0	1951
2	5631500400	180000.0	2	1.00	770	1.0	1933
3	2487200875	604000.0	4	3.00	1960	1.0	1965
4	1954400510	510000.0	3	2.00	1680	1.0	1987

[3]:
```
# Removing the first column="id" , doing it inplace=True
house_price.drop(columns="id",inplace=True)
house_price.head()
```

[3]:

	price	bedrooms	bathrooms	sqft_living	floors	yr_built
0	221900.0	3	1.00	1180	1.0	1955
1	538000.0	3	2.25	2570	2.0	1951
2	180000.0	2	1.00	770	1.0	1933
3	604000.0	4	3.00	1960	1.0	1965
4	510000.0	3	2.00	1680	1.0	1987

Mean Normalization

Mean normalization is a technique to standardize the range of independent variables or features of data. In data processing, it is also known as **feature scaling**. In this technique, we subtract the

mean and then divide the resultant by the standard deviation of each value of the column.

Formula

$$x_i = \frac{x_i - \mu}{max(x_i) - min(x_i)}$$

where,

x_i = ith value of the column

μ = mean of the column

- Separating the X and Y variables

[4]:
```
X = house_price.drop(columns="price")
y = house_price["price"]

X_pred = { 'bedrooms':4, 'bathrooms':2.5, 'sqft_living':2570, 'floors':2,␣
 ↪'yr_built':2005 }
```

- Mean Normalization

[5]:
```
for col in X.columns:

    X_pred[col] = (X_pred[col] - np.mean(X[col]))/( np.max(X[col]) - np.
 ↪min(X[col]) )

    X[col] = (X[col] - np.mean(X[col]))/( np.max(X[col]) - np.min(X[col]) )
```

- To check the model's performance we will split the data into train and test sets

[6]:
```
# Split randomly into 80-20 train-test

shuffled_indices = np.random.permutation(X.shape[0])

train_indices = shuffled_indices[:int(0.8*X.shape[0])]
test_indices = shuffled_indices[int(0.8*X.shape[0]):]

X_train = X.iloc[train_indices]
y_train = y.iloc[train_indices]

X_test = X.iloc[test_indices]
y_test = y.iloc[test_indices]
```

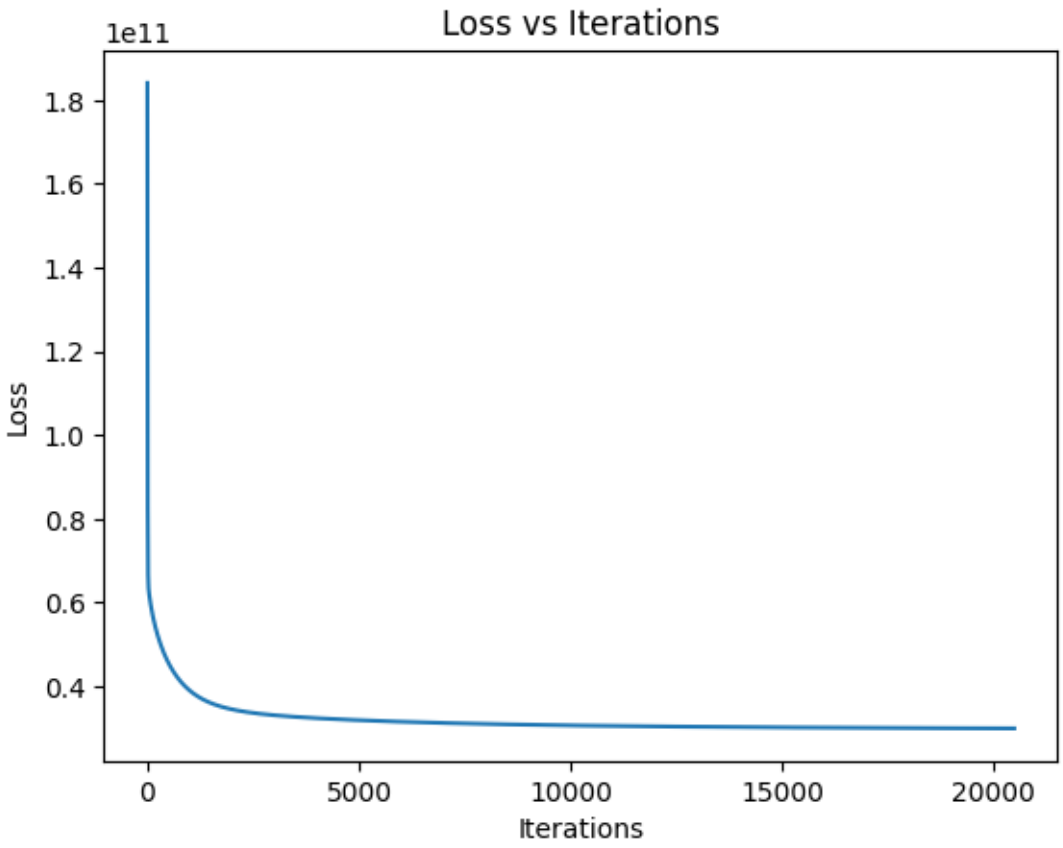
[7]:
```
np.random.seed(42)
batch_gd = BatchGD(alpha=0.1, max_iter=30000, bias=True , tol=1e-6)
```

[8]:
```
batch_gd.fit(X_train,y_train)
```

[9]:
```
batch_gd.weights
```

[9]:
```
array([  540732.19405282, -1061457.44776833,   543127.14367894,
        3588317.83451889,   150676.59915448,  -382560.02746247])
```

[10]:
```
plt.plot(batch_gd.loss_history)
plt.title("Loss vs Iterations")
plt.xlabel("Iterations")
plt.ylabel("Loss")
fig = plt.gcf()
fig.savefig("figures/0201.png")
```



- In the above plot we can see that Loss is smoothly decreasing with the iterations and finally it converges to a value.
- Let's check the RMSE of the model

[11]:
```
def rmse(y_true, y_pred):
    return np.sqrt(np.mean((y_true - y_pred)**2))

y_test_pred = batch_gd.predict(X_test)

y_train_pred = batch_gd.predict(X_train)

rmse(y_train, y_train_pred), rmse(y_test, y_test_pred)
```

[11]:
```
(243470.56608706617, 257704.1440649017)
```

1.0.2 3. Predict the house price using the model, for 4 bedrooms, 2.5 bathrooms, 2570 sq. feet area, 2 floors, 2005 yr. built, and state the difference between the model prediction and actual value (Rs. 719000). Show in % error

[12]:
```
X_pred = np.array(list(X_pred.values()))
X_pred
```

[12]:
```
array([0.01906541, 0.04815533, 0.0369887 , 0.20227641, 0.29560751])
```

[13]:
```
pred_price = batch_gd.predict(X_pred)
actual_price = 719000
```

[14]:
```
pred_price
```

[14]:
```
array([600677.57678534])
```

[15]:
```
# % error
((actual_price - pred_price)/actual_price)*100
```

[15]:
```
array([16.45652618])
```

- Hence error is 16.45%
