week3 code

August 7, 2024

[1]:
```
import pandas as pd
import numpy as np
```

[2]:
```
df = pd.read_csv('diabetes_csv.csv')
```

[3]:
```
df.head
```

[3]:
```
<bound method NDFrame.head of      Pregnancies  Glucose  BloodPressure
SkinThickness  Insulin   BMI  \
0              6      148             72             35        0  33.6
1              1       85             66             29        0  26.6
2              8      183             64              0        0  23.3
3              1       89             66             23       94  28.1
4              0      137             40             35      168  43.1
..           …      …              …              …       …   …
763           10      101             76             48      180  32.9
764            2      122             70             27        0  36.8
765            5      121             72             23      112  26.2
766            1      126             60              0        0  30.1
767            1       93             70             31        0  30.4

     DiabetesPedigreeFunction  Age  Outcome
0                       0.627   50        1
1                       0.351   31        0
2                       0.672   32        1
3                       0.167   21        0
4                       2.288   33        1
..                        …  …       …
763                     0.171   63        0
764                     0.340   27        0
765                     0.245   30        0
766                     0.349   47        1
767                     0.315   23        0

[768 rows x 9 columns]>
```

1. 1. Load data in Pandas.

[4]:
```
df.head
```

[4]:
```
<bound method NDFrame.head of      Pregnancies  Glucose  BloodPressure
SkinThickness  Insulin   BMI  \
0                6      148             72             35        0  33.6
1                1       85             66             29        0  26.6
2                8      183             64              0        0  23.3
3                1       89             66             23       94  28.1
4                0      137             40             35      168  43.1
..             …      …               …              …       …   …
763             10      101             76             48      180  32.9
764              2      122             70             27        0  36.8
765              5      121             72             23      112  26.2
766              1      126             60              0        0  30.1
767              1       93             70             31        0  30.4

     DiabetesPedigreeFunction  Age  Outcome
0                       0.627   50        1
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2                       0.672   32        1
3                       0.167   21        0
4                       2.288   33        1
..                        …  …      …
763                     0.171   63        0
764                     0.340   27        0
765                     0.245   30        0
766                     0.349   47        1
767                     0.315   23        0

[768 rows x 9 columns]>
```

1. 2. Drop columns that aren't useful.

[5]:
```
df.corr()
```

[5]:
```
                          Pregnancies   Glucose  BloodPressure  SkinThickness  \
Pregnancies                  1.000000  0.129459       0.141282      -0.081672
Glucose                      0.129459  1.000000       0.152590       0.057328
BloodPressure                0.141282  0.152590       1.000000       0.207371
SkinThickness               -0.081672  0.057328       0.207371       1.000000
Insulin                     -0.073535  0.331357       0.088933       0.436783
BMI                          0.017683  0.221071       0.281805       0.392573
DiabetesPedigreeFunction    -0.033523  0.137337       0.041265       0.183928
Age                          0.544341  0.263514       0.239528      -0.113970
Outcome                      0.221898  0.466581       0.065068       0.074752

                            Insulin       BMI  DiabetesPedigreeFunction  \
Pregnancies               -0.073535  0.017683                 -0.033523
Glucose                    0.331357  0.221071                  0.137337
BloodPressure              0.088933  0.281805                  0.041265
```

```
SkinThickness              0.436783  0.392573                  0.183928
Insulin                    1.000000  0.197859                  0.185071
BMI                        0.197859  1.000000                  0.140647
DiabetesPedigreeFunction   0.185071  0.140647                  1.000000
Age                       -0.042163  0.036242                  0.033561
Outcome                    0.130548  0.292695                  0.173844

                                Age   Outcome
Pregnancies                0.544341  0.221898
Glucose                    0.263514  0.466581
BloodPressure              0.239528  0.065068
SkinThickness             -0.113970  0.074752
Insulin                   -0.042163  0.130548
BMI                        0.036242  0.292695
DiabetesPedigreeFunction   0.033561  0.173844
Age                        1.000000  0.238356
Outcome                    0.238356  1.000000
```

[6]:
```
df = df.drop(df['Glucose'])
```

[7]:
```
df.columns
```

[7]:
```
Index(['Pregnancies', 'Glucose', 'BloodPressure', 'SkinThickness', 'Insulin',
       'BMI', 'DiabetesPedigreeFunction', 'Age', 'Outcome'],
      dtype='object')
```

1. 3. Drop rows with missing values. df.dropna(axis=0)

1. 4. Create dummy variables.

[8]:
```
features =␣
↪['Pregnancies','Glucose','BloodPressure','SkinThickness','Insulin','BMI','DiabetesPedigreeF
```

[9]:
```
outcomes = ['Outcome']
```

[10]:
```
X = df[features]
y = df[outcomes]
```

[11]:
```
X.columns
```

[11]:
```
Index(['Pregnancies', 'Glucose', 'BloodPressure', 'SkinThickness', 'Insulin',
       'BMI', 'DiabetesPedigreeFunction', 'Age'],
      dtype='object')
```

[12]:
```
y.columns
```

[12]:
```
Index(['Outcome'], dtype='object')
```

1. 5. Take care of missing data.

[13]:
```
df.isnull().sum()
```

[13]:
```
Pregnancies                 0
Glucose                     0
BloodPressure               0
SkinThickness               0
Insulin                     0
BMI                         0
DiabetesPedigreeFunction    0
Age                         0
Outcome                     0
dtype: int64
```

[14]:
```
X=X.fillna(0)
```

1.6 Convert the data frame to NumPy.

[15]:
```
ser = np.array(df, dtype='int32')
```

[16]:
```
ser
```

[16]:
```
array([[  1,  85,  66, …,   0,  31,   0],
       [  8, 183,  64, …,   0,  32,   1],
       [  1,  89,  66, …,   0,  21,   0],
       …,
       [  5, 121,  72, …,   0,  30,   0],
       [  1, 126,  60, …,   0,  47,   1],
       [  1,  93,  70, …,   0,  23,   0]], dtype=int32)
```

[17]:
```
ser.shape
```

[17]:
```
(632, 9)
```

[18]:
```
print(ser.dtype)
print(type(ser))
```

```
int32
<class 'numpy.ndarray'>
```

1. 7. Divide the data set into training data and test data.

[19]:
```
from sklearn.model_selection import train_test_split
```

[20]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.05,␣
↪random_state=0)
```

[21]:
```
X_train.shape
```

[21]:
```
(600, 8)
```

[22]:
```
y_train.shape
```

[22]:
```
(600, 1)
```

0.0.1 2. a. Construct a CSV file with the following attributes:

Study time in hours of ML lab course (x) Score out of 10 (y) The dataset should contain 10 rows.

[23]:
```
# initialize data of lists.
data = {'Hours': [2, 4, 6, 8, 10, 12, 14, 16, 18, 20],
        'Score': [1, 2, 3,4, 5, 6, 7, 8, 9, 10]}

df.to_csv('created.csv')

# Create DataFrame
df = pd.DataFrame(data)
X = df['Hours']
y = df['Score']

# Print the output.
print(df)
```

```
   Hours  Score
0      2      1
1      4      2
2      6      3
3      8      4
4     10      5
5     12      6
6     14      7
7     16      8
8     18      9
9     20     10
```

b. Create a regression model and display the following: Coefficients: B0 (intercept) and B1 (slope)

RMSE (Root Mean Square Error)

Predicted responses

[24]:
```
def linear_regression(X, Y):
    n = len(X)

    # Calculate means
    mean_X = sum(X) / n
    mean_Y = sum(Y) / n

    # Calculate the slope (b) and intercept (a)
```

```
    numerator = sum((X[i] - mean_X) * (Y[i] - mean_Y) for i in range(n))
    denominator = sum((X[i] - mean_X) ** 2 for i in range(n))

    num=0
    den = 0
    for i in range(n):
        num+=(X[i] - mean_X)*(Y[i] - mean_Y)
        den+=(X[i]-mean_X)**2

#     b = numerator / denominator
#     a = mean_Y - b * mean_X


    #eqn : y = a0 + a1.x

    a1 = num/den
    a0 = mean_Y - (a1*mean_X)

    return a0, a1

a, b = linear_regression(X, y)
print("Intercept (a):", a)
print("Slope (b):", b)
```

```
Intercept (a): 0.0
Slope (b): 0.5
```

[25]:
```
#linear model eqn: y = a0 + a1*x => y = 0 + 0.5*x
```

[ ]:
```

```

[26]:
```
def getPredictions(a, b, X_vals, y_vals):
    for x in X_vals:
        y = a + (b*x)
        y_vals.append(y)
```

[27]:
```
x_test = X
y_test = []
getPredictions(a,b,x_test, y_test)
print("predict y: ")
print(y_test)
print("actual y: ")
print(df['Score'])


def getError(y_test, y_train):
        err = 0
```

```
        for i in range(len(y_test)):
            err = err + (y_train[i] - y_test[i])**2
        err = err**0.5
        print ("error: ", err)

getError(y_test, df['Score'] )
```

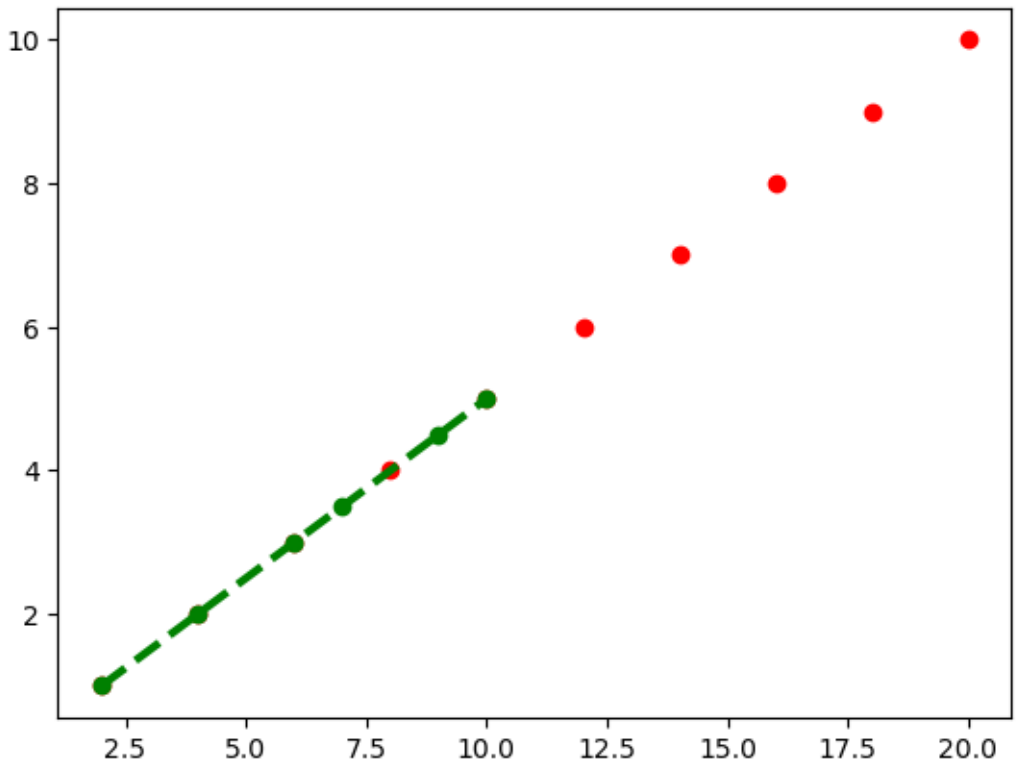
```
predict y:
[1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0]
actual y:
0     1
1     2
2     3
3     4
4     5
5     6
6     7
7     8
8     9
9    10
Name: Score, dtype: int64
error:  0.0
```

[28]:
```
x_test = [2,4,6,7,9,10]
y_test = []
for x in x_test:
    y = a + (b*x)
    y_test.append(y)
print("predicted: ")
print((x_test))
print((y_test))
```

```
predicted:
[2, 4, 6, 7, 9, 10]
[1.0, 2.0, 3.0, 3.5, 4.5, 5.0]
```

[29]:
```
#### plotting input data on scatter plot
```

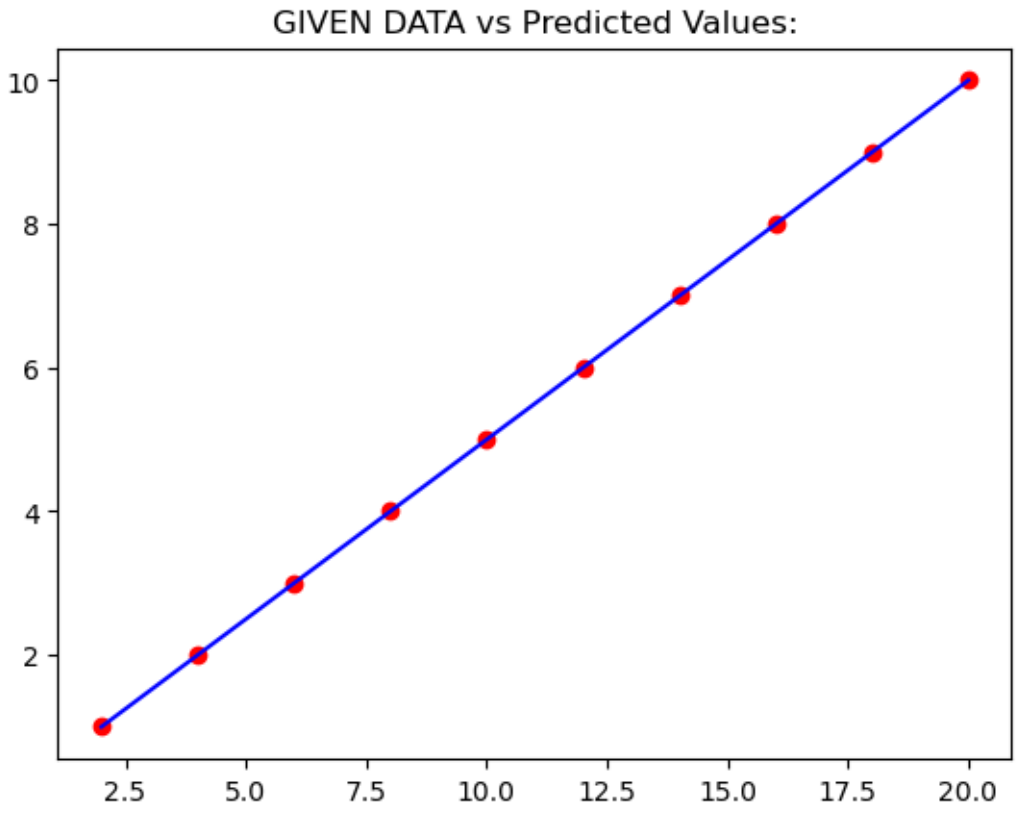
[30]:
```
import matplotlib.pyplot as plt
plt.plot(df['Hours'], df['Score'], 'ro')
plt.plot(x_test, y_test, 'g', linestyle='dashed', marker='o', linewidth=3)
plt.show()
```



rmse

Create a scatter plot of the data points in red color and plot the graph of x vs. predicted y in blue color.

[32]:
```
plt.plot(df['Hours'],df['Score'], 'ro')
plt.title("GIVEN DATA vs Predicted Values:")
plt.plot(df['Hours'], df['Score'], 'b')
plt.show()
```



Calculus Method

[33]:
```
import numpy as np

np.random.seed(0)  # For reproducibility
X = 2 * np.random.rand(100, 1)
y = 4 + 3 * X + np.random.randn(100, 1)

X_b = np.c_[np.ones((100, 1)), X]

theta = np.random.randn(2, 1)  # Random initialization

learning_rate = 0.01
n_iterations = 1000
m = len(X_b)

for iteration in range(n_iterations):
    gradients = 2/m * X_b.T.dot(X_b.dot(theta) - y)
    theta = theta - learning_rate * gradients

print("Estimated coefficients:")
print(f"Intercept (beta_0): {theta[0][0]}")
```

```
print(f"Slope (beta_1): {theta[1][0]}")

X_new = np.array([[0], [2]])
X_new_b = np.c_[np.ones((2, 1)), X_new]
y_predict = X_new_b.dot(theta)

print("Predictions:")
print(y_predict)
```

```
Estimated coefficients:
Intercept (beta_0): 4.20607718142562
Slope (beta_1): 2.9827303563323175
Predictions:
[[ 4.20607718]
 [10.17153789]]
```

2. e. Compare the coefficients obtained using both methods and compare them with the analytical solution.

[34]:
```
print('difference bw intercepts: ')
print(theta[0][0] - a)
```

```
difference bw intercepts:
4.20607718142562
```

[35]:
```
print('diff bw slopes: ')
print(theta[1][0] - b)
```

```
diff bw slopes:
2.4827303563323175
```

2. f. Test your model to predict the score obtained when the study time of a student is 10 hours.

[ ]:
```
test_x = 10
test_y = a + (b*test_x)
print(f'predicted value for x = {test_x} is',test_y)
```

[ ]:
```

```