20182010_ProgrammingHW1_ElkhanIsmayilzada

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1 IE30301 DataMining Programming HW1

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1.0.1 NAME: Elkhan Ismayilzada

1.0.2 Student Number: 20182010

1.0.3 Import Packages

- Do not use packages specified other than below
- However, it is not nessasary to use all the packages below
- For task 1.6, you need to use the package 'statsmodel.api'
- Both packages('sklearn.linear_model' and 'statsmodels.api') can be used to load linear regression model

[1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn import linear_model
import statsmodels.api as sm
from sklearn.model_selection import train_test_split
```

1.1 Task 1. Multiple linear regression [15 points]

1.1 Load Dataset [1 points]

[2]:
```
data = pd.read_csv("diabetes.csv")
```

1.2 Split Dataset into the train & test set [1 points]

- You have to use the specified random seed when dividing the dataset using the function 'train_test_split'
- The specified random seed value is 0
- The ratio of train set and test set is as follows: 70% train set / 30% test set

[3]:
```
x = data.drop("target",axis=1)
y = data['target']
```

```
x_train, x_test, y_train, y_test = train_test_split(x,y,test_size=0.
↪3,random_state=0)
```

1.3 Load model and train the model [2 points]

- Intercept term should be included for training

[4]:
```
x_train = sm.add_constant(x_train)
model = sm.OLS(y_train,x_train)
model = model.fit()
```

1.4 Predict and evaluate the model [4 points]

- Predict target y using the trained model
- Evaluate the trained model using the two metrics (*it is not allowed to use packages for this task)
  1. mean squared error(MSE)
  2. R2 score
- Calculated scores should be placed in the specified cell

[5]:
```
# predict
x_test = sm.add_constant(x_test)
y_hat = model.predict(x_test)
```

[6]:
```
# calculate MSE
mse = np.sum(np.square(y_test-y_hat))/len(y_hat)
```

[7]:
```
# write calculated MSE value here
print(mse)
```

```
3097.1461383877945
```

[8]:
```
# calculate R2
sse = np.sum(np.square(y_test-y_hat))
sst = np.sum(np.square(y_test-np.mean(y_test)))
r_square = 1-sse/sst
```

[9]:
```
# write calculated R2 score here
print(r_square)
```

```
0.3928939845074765
```

1.5 Write the linear regression formula of the trained model [3 points] $\hat{y} = 153.7191 - 52.4699age - 193.5106sex + 579.4828bmi + 272.4640bp - 504.7240s_1 + 241.6844s_2 - 69.7362s_3 + 86.6202s_4 + 721.9558s_5 + 26.7789s_6$

1.6 Check the p-value and find out significant variables [4 points]

- Print p-value of each variable
- List all variables judged to be significant based on the p-value 0.05

[10]:
```
# p-value of each variable
model.pvalues
```

[10]:
```
const    6.839785e-147
age       4.621128e-01
sex       7.598006e-03
bmi       3.094248e-12
bp        8.941189e-04
s1        2.998056e-01
s2        5.345449e-01
s3        7.837443e-01
s4        6.539856e-01
s5        2.935403e-04
s6        7.251985e-01
dtype: float64
```

[11]:
```
# significant variables list
model.pvalues[model.pvalues<0.05]
```

[11]:
```
const    6.839785e-147
sex       7.598006e-03
bmi       3.094248e-12
bp        8.941189e-04
s5        2.935403e-04
dtype: float64
```

1.2 Task 2. Simple linear regression [15 points]

2.1 Select one feataure using information of p-value [1 points]

- Select one of the variables judged to be significant in task 1.6 and mention the variable name you choose
- Remake a dataset only including the variable you choose

[12]:
```
# second most significant variable after const is bmi
x = data['bmi']
y = data['target']
```

2.2 Split Dataset into the train & test set [1 points]

- To perform this task, you need to use the reconstructed dataset in task 2.1
- You have to use the specified random seed when dividing the dataset using the package 'train_test_split'
- The specified random seed value is 0

- The ratio of train set and test set is as follows: 70% train set / 30% test set

[13]:
```
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.
↪3,random_state=0)
```

2.3 Load model and train the model [2 points]

- Intercept term should be included for training

[14]:
```
x_train = sm.add_constant(x_train)
model = sm.OLS(y_train,x_train)
model = model.fit()
```

2.4 Predict and evaluate the results [4 points]

- Predict target y using the trained model
- Evaluate the trained model using the two metrics (*it is not allowed to use packages for this task)
  1. mean squared error(MSE)
  2. R2 score
- Calculated scores should be placed in the specified cell

[15]:
```
# predict
x_test = sm.add_constant(x_test)
y_hat = model.predict(x_test)
```

[16]:
```
# code for caluating MSE
mse = np.sum(np.square(y_test-y_hat))/len(y_hat)
```

[17]:
```
# write calculated MSE value here
print(mse)
```

```
3921.372027424851
```

[18]:
```
# code for calculating R2 score
sse = np.sum(np.square(y_test-y_hat))
sst = np.sum(np.square(y_test-np.mean(y_test)))
r_square = 1-sse/sst
```

[19]:
```
# write calculated R2 score value here
print(r_square)
```

```
0.23132831307953816
```

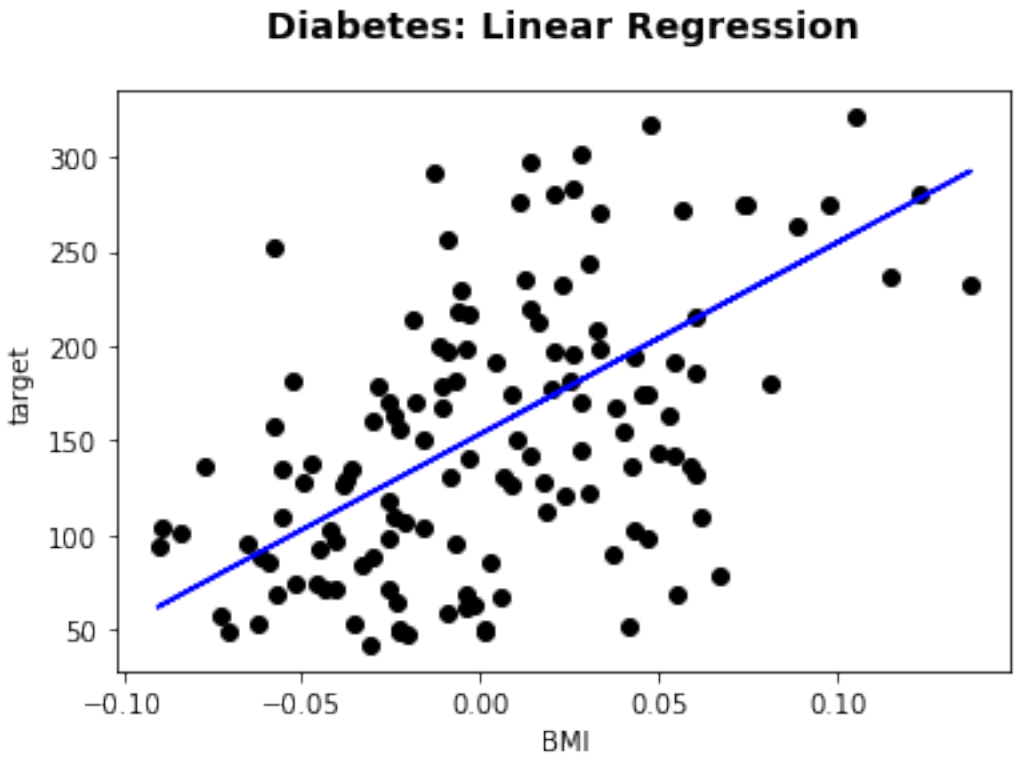
2.5 Write the linear regression formula of the trained model [3 points]

$$\hat{y} = 153.4351 - 1013.1736bmi$$

2.6 Plot graph [4 points]

- Plot data points of test set and draw the line you get from the trained model

[20]:
```
fig, ax = plt.subplots()
ax.set_title("Diabetes: Linear Regression",fontweight=550, fontsize=14,pad=20)
ax.set(xlabel="BMI",ylabel="target")
ax.scatter(x_test[x_test.columns[1]],y_test,c="black")
ax.plot(x_test[x_test.columns[1]],y_hat,color="blue");
```



[ ]: