Module 7 Exercises - Linear Regression

Regression analysis is a statistical process for estimating the relationships among variables. It helps us to understand how the value of the dependent variable changes when th independent variable is changed (while other independent variables are fixed).

> Linear Regression usses a single predictor or input variable

Exercise 1:

Using the pandas library, load the gradedata.csv file as a dataframe. Narrow your data (make the dataframe smaller) by choosing columns that you think can help predict total travel time. Use any method that you've learned so far to help your decision on which columns to keep.

In [30]:

```
import os
os.getcwd()
```

Out[30]:

```
'C:\\Users\\GBTC406001ur\\Downloads'
```

In [1]:

```
import numpy as np # any linear , algebra
import pandas as pd  #data Fram
import matplotlib.pyplot as plt  #making graph #seaborn for beatuiful virsualiza

import sklearn #library for predictive modeling !!!!!
#(commom in analytic world) -Linear/Logistic/tree-decision+ easy [sample]:Boston

%matplotlib inline
```

In [2]:

```
Location = "datasets/gradedata.csv"
df = pd.read_csv(Location)

df.head()
```

Out[2]:

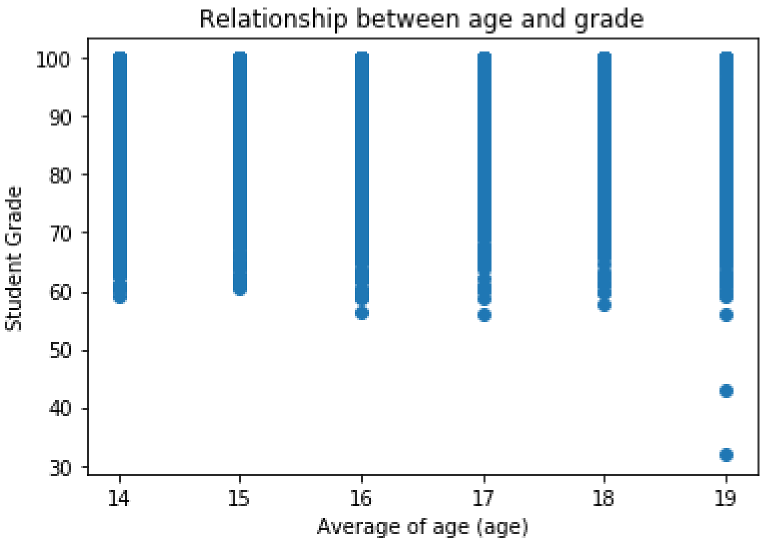
	fname	lname	gender	age	exercise	hours	grade	address
0	Marcia	Pugh	female	17	3	10	82.4	9253 Richardson Road, Matawan, NJ 07747
1	Kadeem	Morrison	male	18	4	4	78.2	33 Spring Dr., Taunton, MA 02780
2	Nash	Powell	male	18	5	9	79.3	41 Hill Avenue, Mentor, OH 44060
3	Noelani	Wagner	female	14	2	7	83.2	8839 Marshall St., Miami, FL 33125
4	Noelani	Cherry	female	18	4	15	87.4	8304 Charles Rd., Lewis Center, OH 43035

In [3]:
```
df.keys()
```

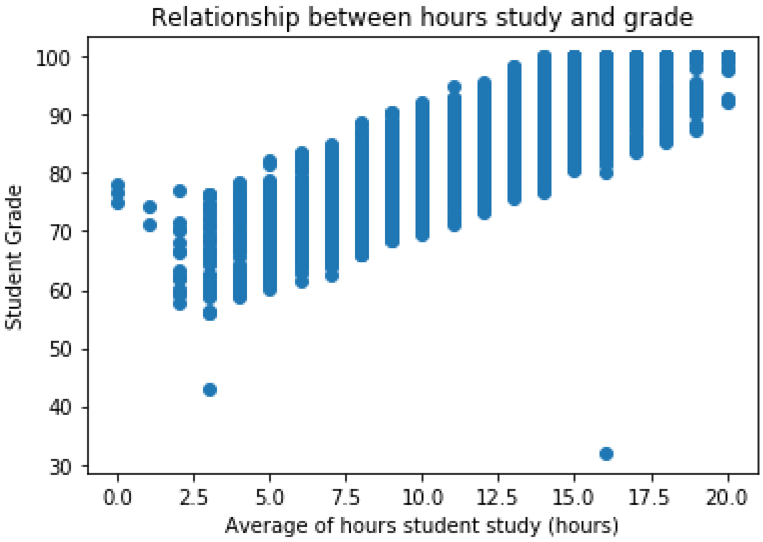
Out[3]:
```
Index(['fname', 'lname', 'gender', 'age', 'exercise', 'hours', 'grade',
       'address'],
      dtype='object')
```

In [4]:
```
df1 = df.drop(['fname', 'lname', 'gender', 'address'], axis =1 )
```

In [5]:
```
plt.scatter(df1['age'], df1['grade']) #plt = from Matplotlib,make scatter box
plt.xlabel("Average of age (age)")
plt.ylabel("Student Grade")
plt.title("Relationship between age and grade")
plt.show()
```



In [6]:
```
plt.scatter(df1['hours'], df1['grade']) #plt = from Matplotlib,make scatter box
plt.xlabel("Average of hours student study (hours)")
plt.ylabel("Student Grade")
plt.title("Relationship between hours study and grade")
plt.show()
```



Exercise 2:

Using the dataframe in the exercise above, clean and prepare your data. This means to eliminate any null (missing) values (either by dropping or filling them) and to transform any data column types to numerical values that a model can interpret. For example, if the column has string values, convert them to integers that best represent their order.

In [7]:
```
df.head()
```

Out[7]:

	fname	lname	gender	age	exercise	hours	grade	address
0	Marcia	Pugh	female	17	3	10	82.4	9253 Richardson Road, Matawan, NJ 07747
1	Kadeem	Morrison	male	18	4	4	78.2	33 Spring Dr., Taunton, MA 02780
2	Nash	Powell	male	18	5	9	79.3	41 Hill Avenue, Mentor, OH 44060
3	Noelani	Wagner	female	14	2	7	83.2	8839 Marshall St., Miami, FL 33125
4	Noelani	Cherry	female	18	4	15	87.4	8304 Charles Rd., Lewis Center, OH 43035

In [8]:
```
df1.count() #no missing value
```

Out[8]:
```
age         2000
exercise    2000
hours       2000
grade       2000
dtype: int64
```

In [9]:
```
# REPLACE empty cells with 0  #with no spicify [column] will fill everything the
#df.fillna(0)
```

In [10]:
```
def numeric_column(x):
    if x=='female':
        return 1
    if x=='male':
        return 0

df['gender_v'] = df['gender'].apply(numeric_column) # gerder_val is a new column
```

In [11]:

```
df.head()
```

Out[11]:

	fname	lname	gender	age	exercise	hours	grade	address	gender_v
0	Marcia	Pugh	female	17	3	10	82.4	9253 Richardson Road, Matawan, NJ 07747	1
1	Kadeem	Morrison	male	18	4	4	78.2	33 Spring Dr., Taunton, MA 02780	0
2	Nash	Powell	male	18	5	9	79.3	41 Hill Avenue, Mentor, OH 44060	0
3	Noelani	Wagner	female	14	2	7	83.2	8839 Marshall St., Miami, FL 33125	1
4	Noelani	Cherry	female	18	4	15	87.4	8304 Charles Rd., Lewis Center, OH 43035	1

Exercise 3:

Using the cleaned dataframe in the exercise above, use the sklearn library to split the data into training and test datasets. Make the test size 30%.

In [12]:

```
#import sklearn
#from sklearn.model_selection import train_test_split

from sklearn.linear_model import LinearRegression



#assign linear regression [function] to a variable
lm = LinearRegression()
lm
```

Out[12]:

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None,
         normalize=False)
```

In [13]:

```
df2 = df.drop(['fname', 'lname', 'gender', 'address'], axis =1 )
```

In [14]:

```
#make a [NEW dataframe = X] X contain all other column we use for predicting..
X = df2.drop('grade', axis = 1)
```

In [15]:
```
df2.head()
```

Out[15]:

	age	exercise	hours	grade	gender_v
0	17	3	10	82.4	1
1	18	4	4	78.2	0
2	18	5	9	79.3	0
3	14	2	7	83.2	1
4	18	4	15	87.4	1

In [16]:
```
#make a [NEW dataframe = X] that only contains predictive features
X = df2.drop('grade', axis = 1)
#y = df2['grade']
```

In [17]:
```
#X_train, X_test, y_train, y_test = train_test_split(X,y, test_size==0.33, randor
```

In [18]:
```
X.head()
```

Out[18]:

	age	exercise	hours	gender_v
0	17	3	10	1
1	18	4	4	0
2	18	5	9	0
3	14	2	7	1
4	18	4	15	1

In [19]:
```
X.columns
```

Out[19]:
```
Index(['age', 'exercise', 'hours', 'gender_v'], dtype='object')
```

In [20]:
```
lm.fit(X, df2['grade'])
```

Out[20]:
```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None,
         normalize=False)
```

In [21]:
```
print('Estimated intercept coefficient:', lm.intercept_)
```

```
Estimated intercept coefficient: 57.63896169839089
```

In [22]:
```
print('Number of coefficients:', len(lm.coef_))
```

```
Number of coefficients: 4
```

In [23]:

```
pd.DataFrame(list(zip(X.columns, lm.coef_)), columns = ['features', 'estimatedCo
```

Out[23]:

	features	estimatedCoefficients
0	age	0.040501
1	exercise	0.984133
2	hours	1.917324
3	gender_v	0.448484

In [24]:

```
lm.predict(X)[0:5]
```

Out[24]:

```
array([80.90159641, 69.9738035 , 80.54455494, 74.04398978, 91.51284876])
```

In [25]:

```
lm.score(X, df2['grade'])
```

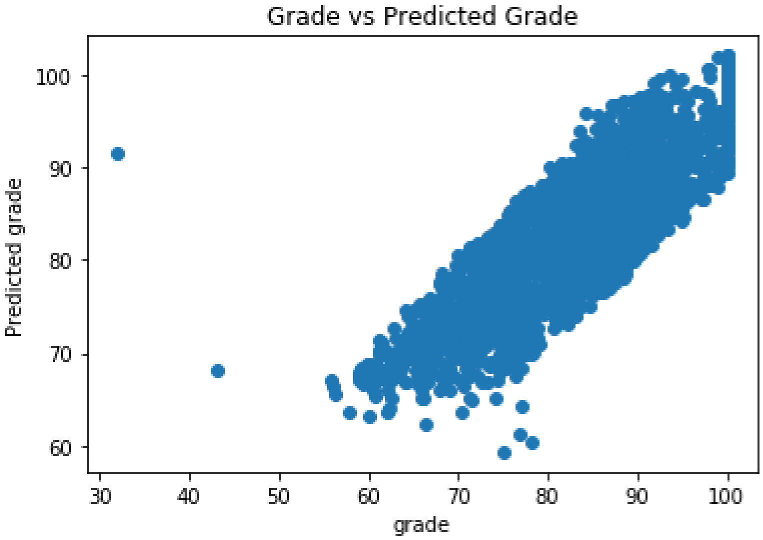
Out[25]:

```
0.6645580504702335
```

model predit 66% correctly

In [26]:

```
plt.scatter(df2['grade'], lm.predict(X))
plt.xlabel("grade")
plt.ylabel("Predicted grade")
plt.title("Grade vs Predicted Grade")
plt.show()
```



Exercise 4:

Using the training data from the previous exercise, set a linear regression function to fit the data (build the model).

In [27]:

```
X_train, X_test, Y_train, Y_test = sklearn.model_selection.train_test_split(
    X, df2.grade, test_size=0.33, random_state = 5) #set up [randow] test size t
print(X_train.shape)
print(X_test.shape)
print(Y_train.shape)
print(Y_test.shape)
```

```
(1340, 4)
(660, 4)
(1340,)
(660,)
```

In [28]:

```
lm.fit(X_train, Y_train)

#above Model Learn from [Training data] True value data and with answer

#NOW

#[predictions] for training and [test data]

pred_train = lm.predict(X_train)
pred_test = lm.predict(X_test)
```

In [29]:

```
#evaluate the accuracy of the model of training vs test
print(lm.score(X_train, Y_train))
print(lm.score(X_test, Y_test))
```

```
0.6827104100890926
0.6252226287723646
```

66% and 62%

Exercise 5:

What is the intercept coefficient (y-intercept) for the linear regression model?

In [31]:

```
#y-intercept for the linear regression formula
print('Estimated intercept coefficient:', lm.intercept_)
```

```
Estimated intercept coefficient: 55.84955854423636
```

Exercise 6:

Use the predict function on the training data and the test data.

In [32]:

```
#show the first 5 values that the model predicted
lm.predict(X)[0:5]
```

Out[32]:

```
array([81.12591366, 69.89641622, 80.5737511 , 73.92670906, 91.94282181])
```

Exercise 7:

Calculate the MSE (mean squared error) of the training and test predictions. How "good" was the linear regression model at predicting the test data compared to the training data?

In [33]:

```
print(lm.score(X_train, Y_train))
print(lm.score(X_test, Y_test))
```

```
0.6827104100890926
0.6252226287723646
```

In [ ]:

```
```