Multiple Linear Regression Model

A linear regression model that contains more than one predictor variable is called a multiple linear regression model. The following model is a multiple linear regression model with two predictor variables, X_1 and X_2. then

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \epsilon$$

For more description Click Here (http://reliawiki.org/index.php/Multiple_Linear_Regression_Analysis)

Datasets Link (tiny.cc/apssdc-datasets)

In [1]:

```
import pandas as pd
```

In [2]:

```
fuel = pd.read_csv('FuelConsumptionCo2.csv')
fuel.head()
```

Out[2]:

	MODELYEAR	MAKE	MODEL	VEHICLECLASS	ENGINESIZE	CYLINDERS	TRANSMISSIO
0	2014	ACURA	ILX	COMPACT	2.0	4	AS
1	2014	ACURA	ILX	COMPACT	2.4	4	M
2	2014	ACURA	ILX HYBRID	COMPACT	1.5	4	AV
3	2014	ACURA	MDX 4WD	SUV - SMALL	3.5	6	AS
4	2014	ACURA	RDX AWD	SUV - SMALL	3.5	6	AS

In [3]:

```
fuel.shape
```

Out[3]:

```
(1067, 13)
```

In [4]:

```
fuel.columns
```

Out[4]:

```
Index(['MODELYEAR', 'MAKE', 'MODEL', 'VEHICLECLASS', 'ENGINESIZE', 'CYLIND
ERS',
       'TRANSMISSION', 'FUELTYPE', 'FUELCONSUMPTION_CITY',
       'FUELCONSUMPTION_HWY', 'FUELCONSUMPTION_COMB',
       'FUELCONSUMPTION_COMB_MPG', 'CO2EMISSIONS'],
      dtype='object')
```

Understanding the Data

`FuelConsumption.csv`:

- **MODELYEAR** e.g. 2014
- **MAKE** e.g. Acura
- **MODEL** e.g. ILX
- **VEHICLE CLASS** e.g. SUV
- **ENGINE SIZE** e.g. 4.7
- **CYLINDERS** e.g 6
- **TRANSMISSION** e.g. A6
- **FUEL CONSUMPTION in CITY(L/100 km)** e.g. 9.9
- **FUEL CONSUMPTION in HWY (L/100 km)** e.g. 8.9
- **FUEL CONSUMPTION COMB (L/100 km)** e.g. 9.2
- **CO2 EMISSIONS (g/km)** e.g. 182 --> low --> 0

In [5]:

```
len(fuel['MAKE'].value_counts())
```

Out[5]:

```
39
```

In [6]:

```
fuel['MAKE'].value_counts()
```

Out[6]:

```
FORD              90
CHEVROLET         86
BMW               64
MERCEDES-BENZ     59
GMC               49
TOYOTA            49
AUDI              49
PORSCHE           44
VOLKSWAGEN        42
DODGE             39
MINI              36
NISSAN            33
KIA               33
CADILLAC          32
JEEP              31
MAZDA             27
HYUNDAI           24
SUBARU            23
LEXUS             22
JAGUAR            22
HONDA             21
INFINITI          21
LAND ROVER        19
CHRYSLER          19
MITSUBISHI        16
BUICK             16
RAM               13
ACURA             12
VOLVO             11
LINCOLN           11
FIAT              10
SCION              9
BENTLEY            8
ROLLS-ROYCE        7
ASTON MARTIN       7
MASERATI           6
LAMBORGHINI        3
SMART              2
SRT                2
Name: MAKE, dtype: int64
```

In [7]:

```
features = fuel[['ENGINESIZE','CYLINDERS','FUELCONSUMPTION_COMB','CO2EMISSIONS']]
features.head()
```

Out[7]:

	ENGINESIZE	CYLINDERS	FUELCONSUMPTION_COMB	CO2EMISSIONS
0	2.0	4	8.5	196
1	2.4	4	9.6	221
2	1.5	4	5.9	136
3	3.5	6	11.1	255
4	3.5	6	10.6	244

In [8]:

```
import seaborn as sns
```

sns.pairplot(data = features)

In [9]:

```
X = features[['ENGINESIZE','FUELCONSUMPTION_COMB']]
Y = features[['CO2EMISSIONS']]
```

In [10]:

```
from sklearn.linear_model import LinearRegression
```

In [11]:

```
reg = LinearRegression() # Regression Object
pred = reg.fit(X,Y)
Y_pred = reg.predict(X)
```

In [12]:

```
reg.score(X,Y)
```

Out[12]:

```
0.8582144778981454
```

In [13]:

```
reg.predict([[2.0,8.5]])
```

Out[13]:

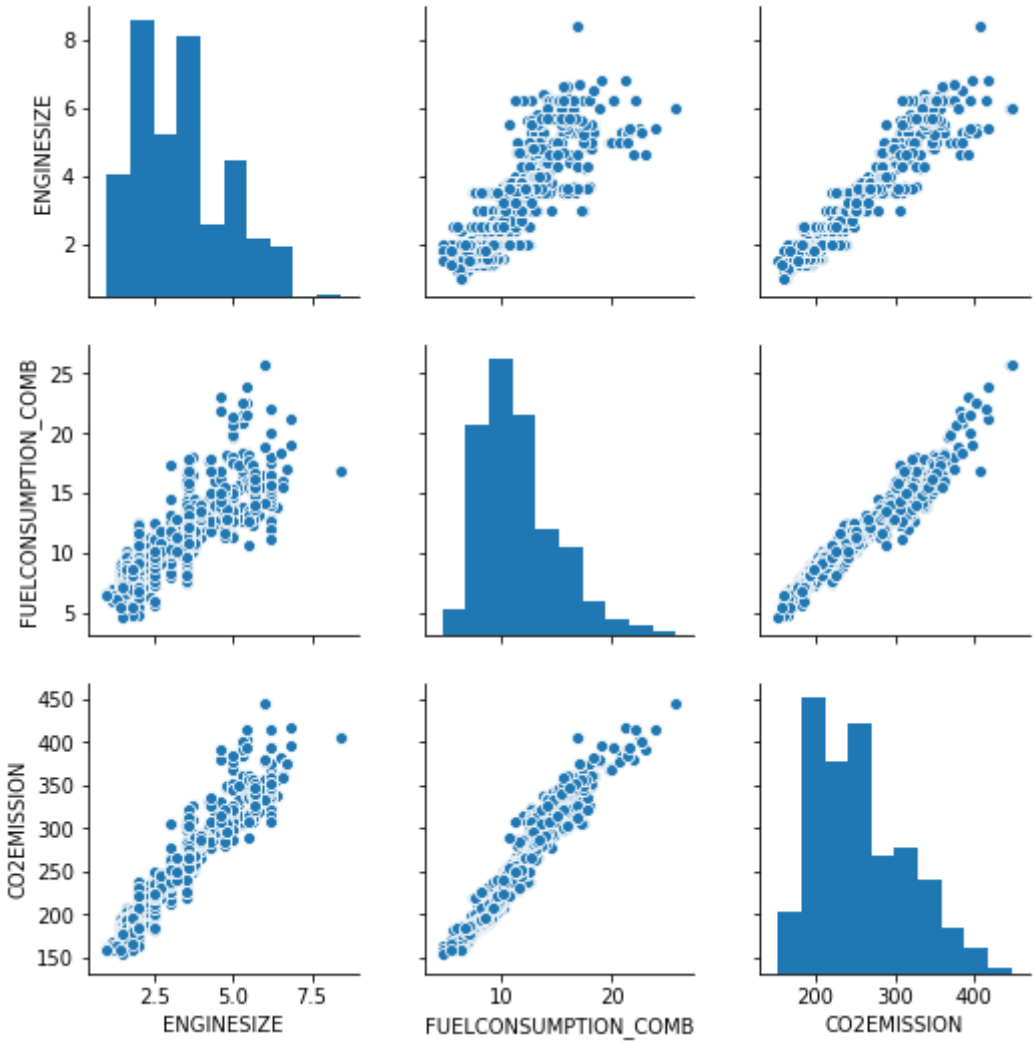
```
array([[200.00402631]])
```

In [14]:

```
df = pd.DataFrame(X)
df['CO2EMISSION'] = pd.DataFrame(Y_pred)
sns.pairplot(df)
```

Out[14]:

```
<seaborn.axisgrid.PairGrid at 0x18d42f396a0>
```



In [15]:

```
reg.coef_
```

Out[15]:

```
array([[19.49628353,  9.72995852]])
```

In [16]:

```
reg.intercept_
```

Out[16]:

```
array([78.30681186])
```

In [17]:

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

In [18]:

```
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size = 0.3, random_state = 7)
```

In [19]:

```
reg1 = LinearRegression()

reg1.fit(X_train,Y_train)

Y_pred = reg1.predict(X_test)

reg1.score(X_test,Y_test)
```

Out[19]:

```
0.8721283450220715
```

In [20]:

```
Y_pred = reg1.predict(X_test)
```

In [21]:

```
reg1.score(X_test,Y_test)
```

Out[21]:

```
0.8721283450220715
```