# 1.) Import the data from CCLE into a new Google Colab file

```
import pandas as pd
from google.colab import drive
import matplotlib.pyplot as plt
import statsmodels.api as smf
```

```
from google.colab import drive
drive.mount(’/content/gdrive/’,force_remount=True)
```

```
    Mounted at /content/gdrive/
```

```
import sklearn as sk
from sklearn.linear_model import LinearRegression
import statsmodels.api as sm
```

```
insurance=pd.read_csv(”/content/gdrive/MyDrive/Econ441B/insurance.csv”)
insurance.head()
```

| | age | sex | bmi | children | smoker | region | charges |
|---|---|---|---|---|---|---|---|
| **0** | 19 | female | 27.900 | 0 | yes | southwest | 16884.92400 |
| **1** | 18 | male | 33.770 | 1 | no | southeast | 1725.55230 |
| **2** | 28 | male | 33.000 | 3 | no | southeast | 4449.46200 |
| **3** | 33 | male | 22.705 | 0 | no | northwest | 21984.47061 |
| **4** | 32 | male | 28.880 | 0 | no | northwest | 3866.85520 |

```
insurance.loc[insurance[’sex’]==’female’,’sex’]=1
insurance.loc[insurance[’sex’]==’male’,’sex’]=0
insurance.loc[insurance[’smoker’]==’yes’,’smoker’]=1
insurance.loc[insurance[’smoker’]==’no’,’smoker’]=0
```

```
from sklearn import preprocessing
insurance[’region’]=preprocessing.LabelEncoder().fit_transform(insurance[’region’])
insurance.head()
```

| | age | sex | bmi | children | smoker | region | charges |
|---|---|---|---|---|---|---|---|
| **0** | 19 | 1 | 27.900 | 0 | 1 | 3 | 16884.92400 |
| **1** | 18 | 0 | 33.770 | 1 | 0 | 2 | 1725.55230 |
| **2** | 28 | 0 | 33.000 | 3 | 0 | 2 | 4449.46200 |
| **3** | 33 | 0 | 22.705 | 0 | 0 | 1 | 21984.47061 |
| **4** | 32 | 0 | 28.880 | 0 | 0 | 1 | 3866.85520 |

# 2.) Split the data into 80/20, in/out sample

```
cut=int((len(insurance)*0.8//1))
```

```
in_data=insurance.iloc[:cut,0:6]
out_data=insurance.iloc[cut:,0:6]
in_target=insurance.iloc[:cut,6]
out_target=insurance.iloc[cut:,6]
```

# 3.) Normalize the Data

```
from sklearn import preprocessing
scaler=preprocessing.StandardScaler().fit(in_data)
in_data_scale = scaler.transform(in_data)
out_data_scale = scaler.transform(out_data)
```

## 4.) Get lambda from Lasso cross validation

```
from sklearn.linear_model import LassoCV
modCV=LassoCV().fit(in_data_scale,in_target)
a=modCV.alpha_
a
```

```
    133.34880015958146
```

## 5.) Run a lambda regression with that Lambda

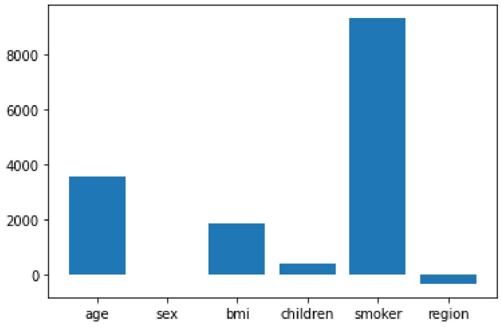
```
from sklearn.linear_model import Lasso
mod1=Lasso(alpha=a).fit(in_data_scale,in_target)
```

```
mod1.coef_
```

```
    array([3564.26137833,    0.        , 1890.8527485 ,  398.24050447,
           9324.84227138, -326.52198757])
```

## 6.) Visualize the coefficients

```
plt.bar(['age','sex','bmi','children','smoker','region'],mod1.coef_)
plt.show()
```



## 7.) Interpret the coefficients

From the plot in part6, we can see that, age, bmi, chilren, smoker is positively correlated with response variable charges. And region(southwest=3,southeast=2,northwest=1,northest=0) is negatively correlated with response variable charges. And sex can be removed from the model.

## 8.) Compare in and out of sample MSE's

```
import numpy as np
from sklearn.metrics import mean_squared_error
from math import sqrt
predict_in_data=mod1.predict(in_data_scale)
print(mean_squared_error(in_target,predict_in_data))
predict_out_data=mod1.predict(out_data_scale)
print(mean_squared_error(out_target,predict_out_data))
```

```
    36490415.101693384
    37252730.724018715
```

As we can see above, the MSE for in-sample data is 36490415.10, which is a little bit lower than the out-sample data which is 37252730.72

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