Assignment 5

1. Choose a REGRESSION dataset (reusing bikeshare is allowed), perform a test/train split, and build a regression model (just like in assignment 3), and calculate the

```
+ Training Error (MSE, MAE)
+ Testing Error (MSE, MAE)
```

2. Choose a CLASSIFICATION dataset (not the adult.data set, The UCI repository has many datasets as well as Kaggle), perform test/train split and create a classification model (your choice but DecisionTree is fine). Calculate

```
+ Accuracy
+ Confusion Matrix
+ Classifcation Report
```

3. (Bonus) See if you can improve the classification model's performance with any tricks you can think of (modify features, remove features, polynomial features)

1) Regression

I located a Medical Cost Personal Dataset here https://www.kaggle.com/datasets/mirichoi0218/insurance?resource=download (https://www.kaggle.com/datasets/mirichoi0218/insurance?resource=download)

In [88]:
```
#Getting ready

import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
import pandas as pd
import numpy as np
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn import linear_model
from sklearn.preprocessing import PolynomialFeatures
from sklearn.metrics import mean_squared_error
from sklearn.metrics import mean_absolute_error
```

In [89]:
```
#Make the Dataframe and check it
dfc = pd.read_csv('insurance.csv')
dfc.head()
```

Out[89]:

	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

In [90]:

Out[90]:
```
Index(['age', 'sex', 'bmi', 'children', 'smoker', 'region', 'charges
'], dtype='object')
```

In [91]:
```
#Age and Charges seem like good variables
x = dfc[['age']]
y = dfc[['charges']]
```

In [93]:
```
linmod = linear_model.LinearRegression()
linmod.fit(x, y)
```

Out[93]:
```
(array([[257.72261867]]), array([3165.88500606]))
```

In [94]:
```
#Train, Test, Split 50/50
from sklearn.model_selection import train_test_split
```

In [95]:

Out[95]:
```
((1338, 1), (669, 1), (669, 1))
```

In [96]:

```
model = LinearRegression()
model.fit(x_train, y_train)
model.coef_, model.intercept_
```

Out[96]:

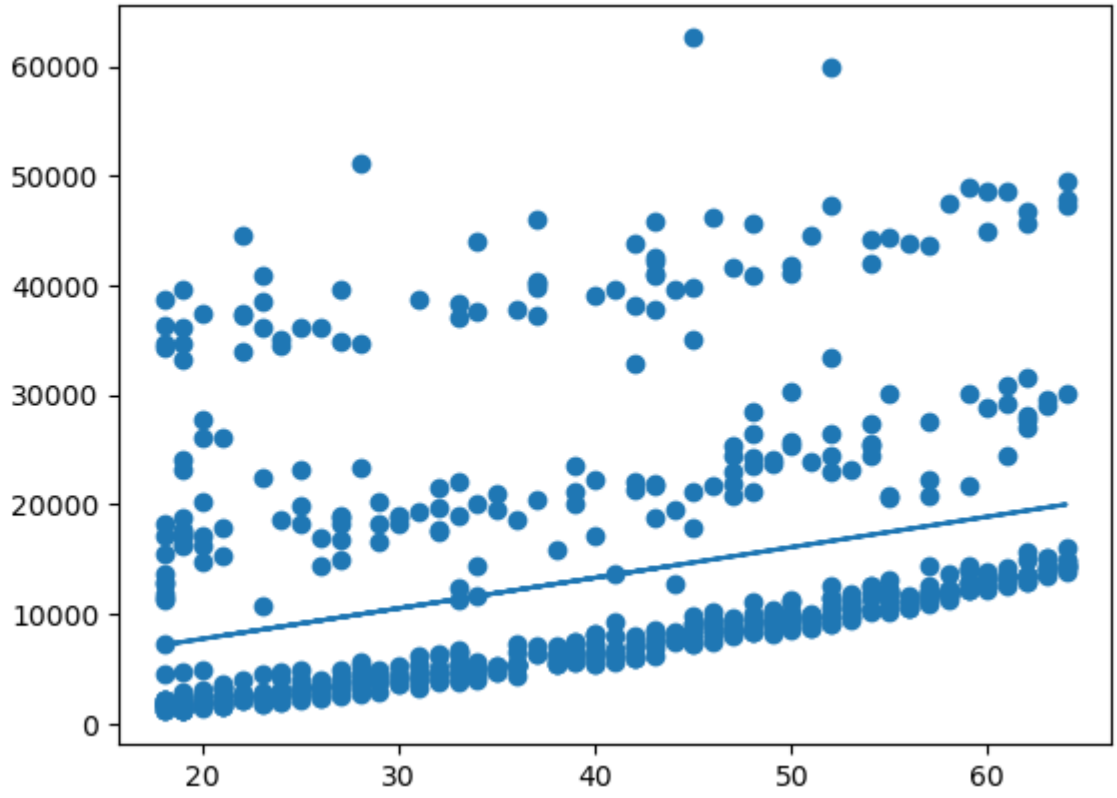
```
(array([[278.71968682]]), array([2148.39906589]))
```

In [107]:

```
plt.scatter(x_test,y_test)
```

Out[107]:

```
[<matplotlib.lines.Line2D at 0x7fb9681843d0>]
```



Train Data MSE

In [98]:

Out[98]:

```
134848387.8763608
```

Train Data MAE

In [99]:

Out[99]:

```
8988.419779992035
```

Test Data MSE

In [100]:

Out[100]:

```
132282967.40553232
```

Test Data MAE

In [101]:

Out[101]:

```
8958.958874443086
```

2) Classification

In [102]:

```python
no_num_col = ['sex', 'region', 'smoker']
x = dfc.copy().drop(no_num_col, axis=1)
x
```

Out[102]:

	age	bmi	children	charges
0	19	27.900	0	16884.92400
1	18	33.770	1	1725.55230
2	28	33.000	3	4449.46200
3	33	22.705	0	21984.47061
4	32	28.880	0	3866.85520
...	...	...	...	...
1333	50	30.970	3	10600.54830
1334	18	31.920	0	2205.98080
1335	18	36.850	0	1629.83350
1336	21	25.800	0	2007.94500
1337	61	29.070	0	29141.36030

1338 rows × 4 columns

In [103]:
```
def bmi_classification(bmi_value):
    if bmi_value < 30:
        return 0
    else:
        return 1

x['obese'] = x['bmi'].apply(bmi_classification)
```

Out[103]:

	age	bmi	children	charges	obese
0	19	27.900	0	16884.92400	0
1	18	33.770	1	1725.55230	1
2	28	33.000	3	4449.46200	1
3	33	22.705	0	21984.47061	0
4	32	28.880	0	3866.85520	0
...	...	...	...	...	...
1333	50	30.970	3	10600.54830	1
1334	18	31.920	0	2205.98080	1
1335	18	36.850	0	1629.83350	1
1336	21	25.800	0	2007.94500	0
1337	61	29.070	0	29141.36030	0

1338 rows × 5 columns

In [104]:
```
x.drop('bmi', axis=1, inplace=True)
```

Out[104]:

	age	children	charges	obese
0	19	0	16884.92400	0
1	18	1	1725.55230	1
2	28	3	4449.46200	1
3	33	0	21984.47061	0
4	32	0	3866.85520	0
...	...	...	...	...
1333	50	3	10600.54830	1
1334	18	0	2205.98080	1
1335	18	0	1629.83350	1
1336	21	0	2007.94500	0
1337	61	0	29141.36030	0

1338 rows × 4 columns

In [105]:
```
[illegible]
```

Out[105]:
```
1    707
0    631
Name: obese, dtype: int64
```

In [106]:
```
#time to get lost in some random forest
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier
```

In [72]:
```
model = DecisionTreeClassifier(criterion='entropy')
[illegible]
```

Out[72]:
```
DecisionTreeClassifier(criterion='entropy')
```

In [73]:
```
[illegible]
```

Out[73]:
```
[('age', 0.1796500645757731),
 ('children', 0.09215165020310372),
 ('charges', 0.7281982852211232)]
```

Test Train Split

In [74]:
```
[illegible]
```

In [75]:
```
[illegible]
```

Out[75]:
```
((1338, 4), (669, 3), (669, 3))
```

```
In [82]: [illegible]
```

```
Out[82]: DecisionTreeClassifier(criterion='entropy')
```

```
In [83]: [illegible]
```

Accuracy

```
In [84]: from sklearn.metrics import (accuracy_score,
                                      classification_report,
                                      confusion_matrix, auc, roc_curve
                                     )
```

```
In [85]: [illegible]
```

```
Out[85]: 0.6158445440956651
```

```
In [125]: [illegible]
```

Confusion Matrix

```
In [86]: [illegible]
```

```
Out[86]: array([[178, 121],
                [136, 234]])
```

Classification Report

```
In [81]: [illegible]
```

```
              precision    recall  f1-score   support

           0       0.57      0.60      0.58       299
           1       0.66      0.64      0.65       370

    accuracy                           0.62       669
   macro avg       0.61      0.62      0.61       669
weighted avg       0.62      0.62      0.62       669
```

3) Bonus

In [110]:
```
bonus_var = ['children', 'region']
bonus_set = dfc.copy().drop(bonus_var, axis=1)
bonus_set
```

Out[110]:

	age	sex	bmi	smoker	charges
0	19	female	27.900	yes	16884.92400
1	18	male	33.770	no	1725.55230
2	28	male	33.000	no	4449.46200
3	33	male	22.705	no	21984.47061
4	32	male	28.880	no	3866.85520
...	...	...	...	...	...
1333	50	male	30.970	no	10600.54830
1334	18	female	31.920	no	2205.98080
1335	18	female	36.850	no	1629.83350
1336	21	female	25.800	no	2007.94500
1337	61	female	29.070	yes	29141.36030

1338 rows × 5 columns

In [111]:
```
bonus_set['smoker'] = bonus_set.smoker.str.contains('yes').astype(int)
bonus_set.smoker.value_counts()
```

Out[111]:
```
0    1064
1     274
Name: smoker, dtype: int64
```

In [114]:

```
bonus_set

#model = DecisionTreeClassifier(criterion='entropy')
```

Out[114]:

	age	sex	bmi	smoker	charges
0	19	female	27.900	1	16884.92400
1	18	male	33.770	0	1725.55230
2	28	male	33.000	0	4449.46200
3	33	male	22.705	0	21984.47061
4	32	male	28.880	0	3866.85520
...	...	...	...	...	...
1333	50	male	30.970	0	10600.54830
1334	18	female	31.920	0	2205.98080
1335	18	female	36.850	0	1629.83350
1336	21	female	25.800	0	2007.94500
1337	61	female	29.070	1	29141.36030

1338 rows × 5 columns

In [115]:

```
bonus_set['sex'] = bonus_set['sex'].replace({'male': 1, 'female': 0})
bonus_set = bonus_set.rename(columns={'sex': 'is_male'})
```

Out[115]:

	age	is_male	bmi	smoker	charges
0	19	0	27.900	1	16884.92400
1	18	1	33.770	0	1725.55230
2	28	1	33.000	0	4449.46200
3	33	1	22.705	0	21984.47061
4	32	1	28.880	0	3866.85520
...	...	...	...	...	...
1333	50	1	30.970	0	10600.54830
1334	18	0	31.920	0	2205.98080
1335	18	0	36.850	0	1629.83350
1336	21	0	25.800	0	2007.94500
1337	61	0	29.070	1	29141.36030

1338 rows × 5 columns

In [117]:

```
x_train, x_test, y_train, y_test = train_test_split(bonus_set.drop(['s
In [118]: [illegible]

Out[118]: ((1338, 3), (669, 4), (669, 4))
```

```
In [119]: [illegible]

Out[119]: DecisionTreeClassifier(criterion='entropy')
```

```
In [120]: [illegible]
```

Accuracy

```
In [121]: [illegible]

Out[121]: 0.9626307922272048
```

```
In [122]: [illegible]
```

Confusion Matrix

```
In [123]: [illegible]

Out[123]: array([[515,  15],
                 [ 10, 129]])
```

Classification Report

```
In [124]: [illegible]

              precision    recall  f1-score   support

           0       0.98      0.97      0.98       530
           1       0.90      0.93      0.91       139

    accuracy                           0.96       669
   macro avg       0.94      0.95      0.94       669
weighted avg       0.96      0.96      0.96       669
```

```
In [ ]:
```