Assignment 5

1. Choose a regression dataset (bikeshare is allowed), perform a test/train split, and build a regression model (just like in assingnment 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)

In [175…

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
from sklearn import linear_model
from sklearn.model_selection import train_test_split
from sklearn.metrics import (mean_squared_error,
                             mean_absolute_error,
                             accuracy_score,
                             classification_report,
                             confusion_matrix, auc, roc_curve)
```

Question 1

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

- Training Error (MSE, MAE)
- Testing Error (MSE, MAE)

In [176…

```
college = pd.read_csv('../data/College.csv')
college.head()
```

Out[176]:

	Unnamed: 0	Private	Apps	Accept	Enroll	Top10perc	Top25perc	F.Undergrad	P.Undergrad	Outstate
0	Abilene Christian University	Yes	1660	1232	721	23	52	2885	537	7440
1	Adelphi University	Yes	2186	1924	512	16	29	2683	1227	12280
2	Adrian College	Yes	1428	1097	336	22	50	1036	99	11250
3	Agnes Scott	Yes	417	349	137	60	89	510	63	12960

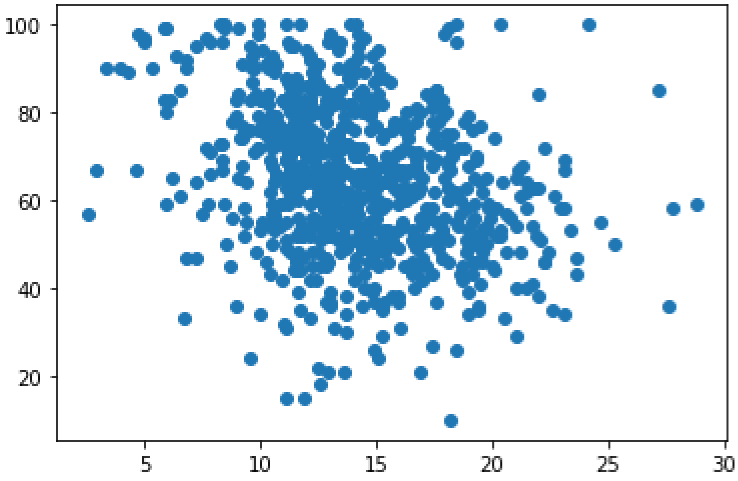
	College									
4	Alaska Pacific University	Yes	193	146	55	16	44	249	869	7560

In [177…

```
df = college[['S.F.Ratio','Grad.Rate']]
df = df[(df['Grad.Rate'] <= 100) & (df['S.F.Ratio'] < 35)]
x = np.array(df['S.F.Ratio']).reshape(-1, 1)
y = np.array(df['Grad.Rate'])
plt.scatter(x,y)
```

Out[177]:

```
<matplotlib.collections.PathCollection at 0x7fcc42cfca00>
```



For my regression model, I chose the College dataset to regress the dependent variable of graduation rate against student-to-faculty ratio.

In [178…

```
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=.25)
```

In [179…

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

Out[179]:

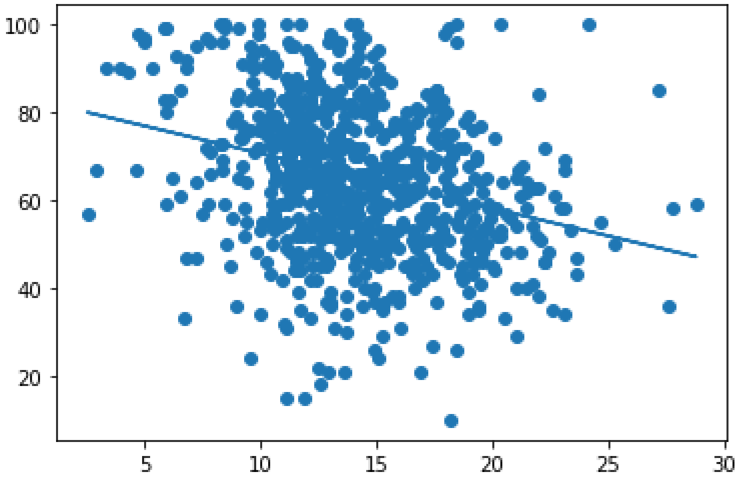
```
(array([-1.25036188]), 83.13720320362248)
```

In [180…

```
plt.scatter(x,y)
plt.plot(x, np.dot(x, linear.coef_) + linear.intercept_)
```

Out[180]:

```
[<matplotlib.lines.Line2D at 0x7fcc336b8f10>]
```



```
mean_squared_error(y_test, np.dot(x_test, linear.coef_) + linear.intercept_)
```

In [181…

```
```

Out[181]:

```
299.5440736081614
```

In [182…

```
mean_squared_error(y_train, np.dot(x_train, linear.coef_) + linear.intercept_)
```

Out[182]:

```
252.3663149961931
```

In [183…

```
mean_absolute_error(y_test, np.dot(x_test, linear.coef_) + linear.intercept_)
```

Out[183]:

```
13.73567513862891
```

In [184…

```
mean_absolute_error(y_train, np.dot(x_train, linear.coef_) + linear.intercept_)
```

Out[184]:

```
12.67822124125226
```

Question 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

In [185…

```
headers = ['wife_age','wife_edu','husband_edu','num_children',
            'wife_religion','wife_work','husband_job','sol_index',
           'media_exposure','contra_method']
contra = pd.read_csv('../add_data/cmc.data',names = headers)
contra.head()
```

Out[185]:

	wife_age	wife_edu	husband_edu	num_children	wife_religion	wife_work	husband_job	sol_index	m
0	24	2	3	3	1	1	2	3	
1	45	1	3	10	1	1	3	4	
2	43	2	3	7	1	1	3	4	
3	42	3	2	9	1	1	3	3	
4	36	3	3	8	1	1	3	2	

For my classification dataset, I chose UCI's Contraception Method Choice dataset, a subset of the 1987 National Indonesia Contraceptive Prevalence Survey. The samples are married women who were either not pregnant or do not know if they were at the time of interview. The problem is to predict the current contraceptive method choice (no use, long-term methods, or short-term methods) of a woman based on her demographic and socio-economic characteristics.

In [186…

```
x2_train, x2_test, y2_train, y2_test = train_test_split(contra.drop(['contra_method'], a
```

In [187…

```
from sklearn.tree import DecisionTreeClassifier
clf = DecisionTreeClassifier(criterion='entropy')
clf.fit(x2_train, y2_train)
list(zip(contra.drop(['contra_method'], axis=1).columns, clf.feature_importances_))
```

```
[('wife_age', 0.3310424070378592),
```

Out[187]:
```
 ('wife_edu', 0.08542633973340909),
 ('husband_edu', 0.06921214948085026),
 ('num_children', 0.20241098682850717),
 ('wife_religion', 0.04604852009657069),
 ('wife_work', 0.04282123283753735),
 ('husband_job', 0.09893330963345284),
 ('sol_index', 0.10666790090860613),
 ('media_exposure', 0.017437153443207 27)]
```

In [188…
```
predictions = clf.predict(x2_test)
accuracy_score(y2_test, predictions)
```

Out[188]:
```
0.5
```

In [189…
```
confusion_matrix(y2_test, predictions)
```

Out[189]:
```
array([[158,  35,  66],
       [ 44,  47,  49],
       [ 58,  43,  90]])
```

In [190…
```
print(classification_report(y2_test, predictions))
```

```
              precision    recall  f1-score   support

           1       0.61      0.61      0.61       259
           2       0.38      0.34      0.35       140
           3       0.44      0.47      0.45       191

    accuracy                           0.50       590
   macro avg       0.47      0.47      0.47       590
weighted avg       0.50      0.50      0.50       590
```

Bonus

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

In [191…
```
improve = contra.copy()
improve['contra_use'] = improve['contra_method']>1
improve['contra_use'] = improve['contra_use'].astype(int)
improve.head()
```

Out[191]:

	wife_age	wife_edu	husband_edu	num_children	wife_religion	wife_work	husband_job	sol_index	m
0	24	2	3	3	1	1	2	3	
1	45	1	3	10	1	1	3	4	
2	43	2	3	7	1	1	3	4	
3	42	3	2	9	1	1	3	3	
4	36	3	3	8	1	1	3	2	

In [192…
```
x3_train, x3_test, y3_train, y3_test = train_test_split(improve.drop(['contra_method','c
```

In [193…
```
clf2 = DecisionTreeClassifier(criterion='entropy')
clf2.fit(x3_train, y3_train)
list(zip(improve.drop(['contra_method','contra_use'], axis=1).columns, clf2.feature_impo
```

Out[193]:
```
[('wife_age', 0.35571946122733356),
 ('wife_edu', 0.07510807952251299),
 ('husband_edu', 0.0524814812329207),
 ('num_children', 0.23347609013661205),
 ('wife_religion', 0.03406725618236256),
 ('wife_work', 0.04989072513071268),
 ('husband_job', 0.09386182854096084),
 ('sol_index', 0.08943011658197891),
 ('media_exposure', 0.015964961444605595)]
```

In [194…

```
predictions2 = clf2.predict(x3_test)
accuracy_score(y3_test, predictions2)
```

Out[194]:

```
0.6440677966101694
```

In [195…

```
confusion_matrix(y3_test, predictions2)
```

Out[195]:

```
array([[151, 107],
       [103, 229]])
```

In [196…

```
print(classification_report(y3_test, predictions2))
```

```
              precision    recall  f1-score   support

           0       0.59      0.59      0.59       258
           1       0.68      0.69      0.69       332

    accuracy                           0.64       590
   macro avg       0.64      0.64      0.64       590
weighted avg       0.64      0.64      0.64       590
```

After failing to improve accuracy or the classification report after numerous iterations of removing features from my Question 2 model, I chose to re-classify the contraception method column as a dummy variable based on contraception use (short-term and long-term use both classified as 1). With this modification to the dependent variable, I was able to see a marked improvement in the model's accuracy and classification statistics, though precision of no contraception usage (0 in the second model, 1 in the first) dropped slightly.