In [14]:
```
#import packages and clean data before running predictive analysis
import numpy as np
import pandas as pd
from sklearn import linear_model
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
import sklearn
from sklearn import datasets
from sklearn.preprocessing import StandardScaler
from sklearn import preprocessing
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
from sklearn.model_selection import cross_val_score, train_test_split
from sklearn import metrics
from sklearn.metrics import classification_report
pd.set_option('display.max_columns', None)
df = pd.read_csv (r'C:\Users\fahim\Documents\0_WGUDocuments\d209\medical_clean.csv')
df.head()
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 50 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   CaseOrder           10000 non-null  int64
 1   Customer_id         10000 non-null  object
 2   Interaction         10000 non-null  object
 3   UID                 10000 non-null  object
 4   City                10000 non-null  object
 5   State               10000 non-null  object
 6   County              10000 non-null  object
 7   Zip                 10000 non-null  int64
 8   Lat                 10000 non-null  float64
 9   Lng                 10000 non-null  float64
 10  Population          10000 non-null  int64
 11  Area                10000 non-null  object
 12  TimeZone            10000 non-null  object
 13  Job                 10000 non-null  object
 14  Children            10000 non-null  int64
 15  Age                 10000 non-null  int64
 16  Income              10000 non-null  float64
 17  Marital             10000 non-null  object
 18  Gender              10000 non-null  object
 19  ReAdmis             10000 non-null  object
 20  VitD_levels         10000 non-null  float64
 21  Doc_visits          10000 non-null  int64
 22  Full_meals_eaten    10000 non-null  int64
 23  VitD_supp           10000 non-null  int64
 24  Soft_drink          10000 non-null  object
 25  Initial_admin       10000 non-null  object
 26  HighBlood           10000 non-null  object
 27  Stroke              10000 non-null  object
 28  Complication_risk   10000 non-null  object
 29  Overweight          10000 non-null  object
 30  Arthritis           10000 non-null  object
 31  Diabetes            10000 non-null  object
 32  Hyperlipidemia      10000 non-null  object
 33  BackPain            10000 non-null  object
 34  Anxiety             10000 non-null  object
 35  Allergic_rhinitis   10000 non-null  object
 36  Reflux_esophagitis  10000 non-null  object
 37  Asthma              10000 non-null  object
 38  Services            10000 non-null  object
 39  Initial_days        10000 non-null  float64
 40  TotalCharge         10000 non-null  float64
 41  Additional_charges  10000 non-null  float64
 42  Item1               10000 non-null  int64
 43  Item2               10000 non-null  int64
 44  Item3               10000 non-null  int64
 45  Item4               10000 non-null  int64
 46  Item5               10000 non-null  int64
 47  Item6               10000 non-null  int64
 48  Item7               10000 non-null  int64
 49  Item8               10000 non-null  int64
dtypes: float64(7), int64(16), object(27)
memory usage: 3.8+ MB
```

In [3]:
```
#check if there are any missing data entries
df.isna().any()
```

Out[3]:
```
CaseOrder           False
Customer_id         False
Interaction         False
UID                 False
City                False
State               False
County              False
Zip                 False
Lat                 False
Lng                 False
Population          False
Area                False
TimeZone            False
Job                 False
Children            False
Age                 False
Income              False
Marital             False
Gender              False
ReAdmis             False
VitD_levels         False
Doc_visits          False
Full_meals_eaten    False
VitD_supp           False
Soft_drink          False
Initial_admin       False
HighBlood           False
Stroke              False
Complication_risk   False
Overweight          False
Arthritis           False
Diabetes            False
Hyperlipidemia      False
BackPain            False
Anxiety             False
Allergic_rhinitis   False
Reflux_esophagitis  False
Asthma              False
Services            False
Initial_days        False
TotalCharge         False
Additional_charges  False
Item1               False
Item2               False
Item3               False
Item4               False
Item5               False
Item6               False
Item7               False
Item8               False
dtype: bool
```

In [4]:
```
#check if there are any duplicate data entries in columns
df[df.duplicated()]
```

Out[4]:

CaseOrder	Customer_id	Interaction	UID	City	State	County	Zip	Lat	Lng	Population	Area	TimeZone	Job	Children	Age	Income	Marital	Gender	ReAdmis	VitD_levels	Doc_visits	Full_meals_eaten	VitD_supp	Soft_drink	Initial_admin	HighBlood	Stroke	Complication_risk	Ov
0 rows × 50 columns																													

In [5]:
```
#check if there are any duplicated columns - if there are none than the output should say False
df.columns.duplicated().any()
```

Out[5]:
```
False
```

In [6]:
```
#check if there are any duplicated rows - if there are none than the output should say False
df.duplicated().any()
```

Out[6]:
```
False
```

In [7]:
```
#remmove the demographic data categories deemed unecessary during our data preparation plan
df = df.drop(['CaseOrder','Customer_id','Interaction','UID','City','State','County','Zip','Lat','Lng','Population','Area','TimeZone','Job'], axis=1)
```

In [8]:
```
#rename the survey columns to their respective titles so that they can be more easily identified
df.rename(columns={'Item1':'Timely_admis','Item2':'Timely_treat','Item3':'Timely_visits','Item4':'Reliability','Item5':'Options','Item6':'Hrs_treat','Item7':'Courteous','Item8':'Active_listen'},inplace=True)
```

In [9]:
```
#check to see that the survey columns were renamed correctly and that the demographic categories were removed
df.head()
```

Out[9]:

	Children	Age	Income	Marital	Gender	ReAdmis	VitD_levels	Doc_visits	Full_meals_eaten	VitD_supp	Soft_drink	Initial_admin	HighBlood	Stroke	Complication_risk	Overweight	Arthritis	Diabetes	Hyperlipidemia	BackPain	Anxiety	Allergic_rhinitis	Reflux_esophagitis	Asthma
0	1	53	86575.93	Divorced	Male	No	19.141466	6	0	0	No	Emergency Admission	Yes	No	Medium	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes
1	3	51	46805.99	Married	Female	No	18.940352	4	2	1	No	Emergency Admission	Yes	No	High	Yes	No	No	No	No	No	No	Yes	No
2	3	53	14370.14	Widowed	Female	No	18.057507	4	1	0	No	Elective Admission	Yes	No	Medium	Yes	No	Yes	No	No	No	No	No	No
3	0	78	39741.49	Married	Male	No	16.576858	4	1	0	No	Elective Admission	No	Yes	Medium	No	Yes	No	No	No	No	No	Yes	Yes
4	1	22	1209.56	Widowed	Female	No	17.439069	5	0	2	Yes	Elective Admission	No	No	Low	No	No	No	No	Yes	No	No	No	No

In [10]:
```
#create a new dataframe for the predictive analysis containing the target variable and chosen predictor variables
medpredict_df_new=df[['Age','Doc_visits','Initial_days','TotalCharge','Additional_charges', 'Initial_admin','Stroke','Complication_risk','ReAdmis']].copy()
```

In [11]:
```
#change the responses for Initial_admin, Stroke, and Complication_risk to numeric values and export
medpredict_df_new['Initial_admin']=medpredict_df_new['Initial_admin'].replace({'Elective Admission':0,'Observation Admission':0,'Emergency Admission':1}, inplace=True)
medpredict_df_new['Complication_risk']=medpredict_df_new['Complication_risk'].replace({'Low':'Medium','High'}, {0,1,2}, inplace=True)
medpredict_df_new['Stroke']=medpredict_df_new['Stroke'].replace({'Yes','No'},{1,0},inplace=True)
medpredict_df_new.head()
medpredict_df_new.to_csv(r'C:\Users\fahim\Documents\0_WGUDocuments\d209\medical_D209TASK2PREPARED1FINAL.csv', index=False)
```

In [16]:
```
#scale the dataset to prepare for the application of Random Forest
predictors = medpredict_df_new.columns[medpredict_df_new.dtypes.apply(lambda c: np.issubdtype(c, np.number))]
scaler=StandardScaler()
medpredict_df_new[predictors] = scaler.fit_transform(medpredict_df_new[predictors])
```

In [17]:
```
#convert the values of the target variable into numeric variables
medpredict_df_new['ReAdmis']=df.ReAdmis.map(dict(Yes=1, No=0))
```

In [19]:
```
#show scaled data to make sure that everything was done correctly
medpredict_df_new.head()
```

Out[19]:

	Age	Doc_visits	Initial_days	TotalCharge	Additional_charges	Initial_admin	Stroke	Complication_risk	ReAdmis
0	-0.024795	0.944647	-0.907310	-0.727185	0.765005	0.895459	-0.498906	-0.168873	0
1	-0.121706	-0.967981	-0.734595	-0.513228	0.715114	0.895459	-0.498906	1.200737	0
2	-0.024795	-0.967981	-1.122632	-1.319983	0.699635	-1.510396	-0.498906	-0.168873	0
3	1.186592	-0.967981	-1.244503	-1.465517	0.009004	-1.510396	2.004366	-0.168873	0
4	-1.529914	-0.011667	-1.261991	-1.467285	-1.408991	-1.510396	-0.498906	-1.538483	0

In [21]:
```
#to begin predictive analysis, seperate data into testing and training datasets
train , test = train_test_split(medpredict_df_new,test_size=0.2b, random_state=42)
x_train=train.drop('ReAdmis', axis=1)
y_train=train['ReAdmis']
x_test=test.drop('ReAdmis',axis=1)
y_test=test['ReAdmis']
```

In [22]:
```
#export the testing and training files
x_train.to_csv(r'C:\Users\fahim\Documents\0_WGUDocuments\d209\medical_xtrain2final.csv', index = False)
x_test.to_csv(r'C:\Users\fahim\Documents\0_WGUDocuments\d209\medical_xtest2final.csv', index = False)
y_train.to_csv(r'C:\Users\fahim\Documents\0_WGUDocuments\d209\medical_ytrain2final.csv', index = False)
y_test.to_csv(r'C:\Users\fahim\Documents\0_WGUDocuments\d209\medical_ytest2final.csv', index = False)
```

In [23]:
```
#import RandomForestClassifier and create the model to run this analysis
from sklearn.ensemble import RandomForestClassifier
clf = RandomForestClassifier(bootstrap = True, class_weight = None, criterion = 'gini', max_depth = None, max_features = 'auto', max_leaf_nodes = None, min_impurity_decrease = 0.0, min_samples_leaf = 1, min_samples_split = 2, min_
clf.fit(x_train,y_train)
```

```
C:\Users\fahim\AppData\Local\Programs\Python\Python310\lib\site-packages\sklearn\ensemble\_forest.py:427: FutureWarning: `max_features='auto'` has been deprecated in 1.1 and will be removed in 1.3. To keep the past behaviour, exp
licitly set `max_features='sqrt'` or remove this parameter as it is also the default value for RandomForestClassifiers and ExtraTreesClassifiers.
  warn(
```

Out[23]:
```
RandomForestClassifier(max_features='auto', n_jobs=1)
```

In [24]:
```
#Save the created predicitions of the model
y_pred=clf.predict(x_test)
```

In [25]:
```
#Now show the predictions vs actual values
pd.DataFrame(data={'Predicted': y_pred, 'Actual': y_test}).head(15)
```

Out[25]:

	Predicted	Actual
6252	0	0
4684	0	0
1731	0	0
4742	0	0
4521	0	0
6340	0	0
576	0	0
5202	1	1
6363	1	1
439	0	0
2750	0	0
7487	0	0
5272	0	0
5653	1	1
3999	0	0

In [26]:
```
#Print out the Classification report for this analysis
from sklearn.metrics import classification_report
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       0.98      0.99      0.98      1291
           1       0.98      0.96      0.97       709

    accuracy                           0.98      2000
   macro avg       0.98      0.97      0.98      2000
weighted avg       0.98      0.98      0.98      2000
```

In [27]:
```
#Print the accuracy score; the desired score should be 95% or above
from sklearn.metrics import accuracy_score
accuracy = accuracy_score(y_test, y_pred)
print(accuracy)
```

```
0.979
```

In [28]:
```
#Print the recall score
from sklearn.metrics import recall_score
recall_score(y_test, y_pred, average='weighted')
```

Out[28]:
```
0.979
```

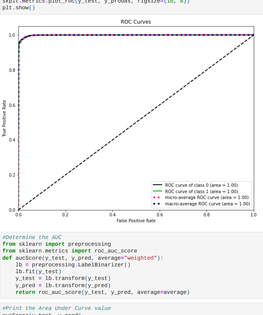
In [29]:
```
#Print precision Score
from sklearn.metrics import precision_score
precision_score(y_test, y_pred, average='weighted')
```

Out[29]:
```
0.9790091843766366
```

In [31]:
```
#Print F1 Score
from sklearn.metrics import f1_score
f1_score(y_test, y_pred, average='weighted')
```

Out[31]:
```
0.9789519247231111
```

In [32]:
```
#Create a plot showing the ROC curves
import scikitplot as skplt
y_probas=clf.predict_proba(x_test)
skplt.metrics.plot_roc(y_test, y_probas, figsize=(10, 8))
plt.show()
```



In [33]:
```
#Determine the AUC
from sklearn import preprocessing
from sklearn.metrics import roc_auc_score
def aucScore(y_test, y_pred, average="weighted"):
    lb = preprocessing.LabelBinarizer()
    lb.fit(y_test)
    y_test = lb.transform(y_test)
    y_pred = lb.transform(y_pred)
    return roc_auc_score(y_test, y_pred, average=average)
```

In [34]:
```
#Print the Area Under Curve value
aucScore(y_test, y_pred)
```

Out[34]:
```
0.9748317253329167
```

In [36]:
```
#Calculate and Print the Mean Squared Error value
from sklearn.metrics import mean_squared_error
mean_squared_error(y_test,y_pred)
```

Out[36]:
```
0.021
```

In [ ]:
```

```