In [37]:
```
import numpy as np
import pandas as pd

from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split,GridSearchCV,RandomizedSea
from sklearn.metrics import confusion_matrix,accuracy_score,classification_repo
from sklearn.tree import DecisionTreeClassifier,plot_tree
from sklearn.ensemble import RandomForestClassifier,AdaBoostClassifier
import seaborn as sns
import matplotlib.pyplot as plt
```

In [2]:
```
#import numpy as np
#import pandas as pd
#from sklearn.linear_model import LogisticRegression
#from sklearn.model_selection import train_test_split,GridSearchCV,RandomizedSe
#from sklearn.metrics import confusion_matrix,accuracy_score,classification_rep
#from sklearn.tree import DecisionTreeClassifier,plot_tree
#from sklearn.ensemble import RandomForestClassifier,AdaBoostClassifier
#import matplotlib.pyplot as plt
#import seaborn as sns
```

1: Problem Statement

In [3]:
```
#Target Column="insuranceclaim"(Statistical Binary Classification)
```

2: Data Gathering

In [4]:
```
df=pd.read_csv(r"C:\Users\Dell\Downloads\insurance2.csv")
df
```

Out[4]:

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

1338 rows × 8 columns

3: EDA(Exploratory data analysis)

In [5]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1338 entries, 0 to 1337
Data columns (total 8 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   age             1338 non-null   int64  
 1   sex             1338 non-null   int64  
 2   bmi             1338 non-null   float64
 3   children        1338 non-null   int64  
 4   smoker          1338 non-null   int64  
 5   region          1338 non-null   int64  
 6   charges         1338 non-null   float64
 7   insuranceclaim  1338 non-null   int64  
dtypes: float64(2), int64(6)
memory usage: 83.8 KB
```

In [6]:
```
df.shape
```

Out[6]:
```
(1338, 8)
```

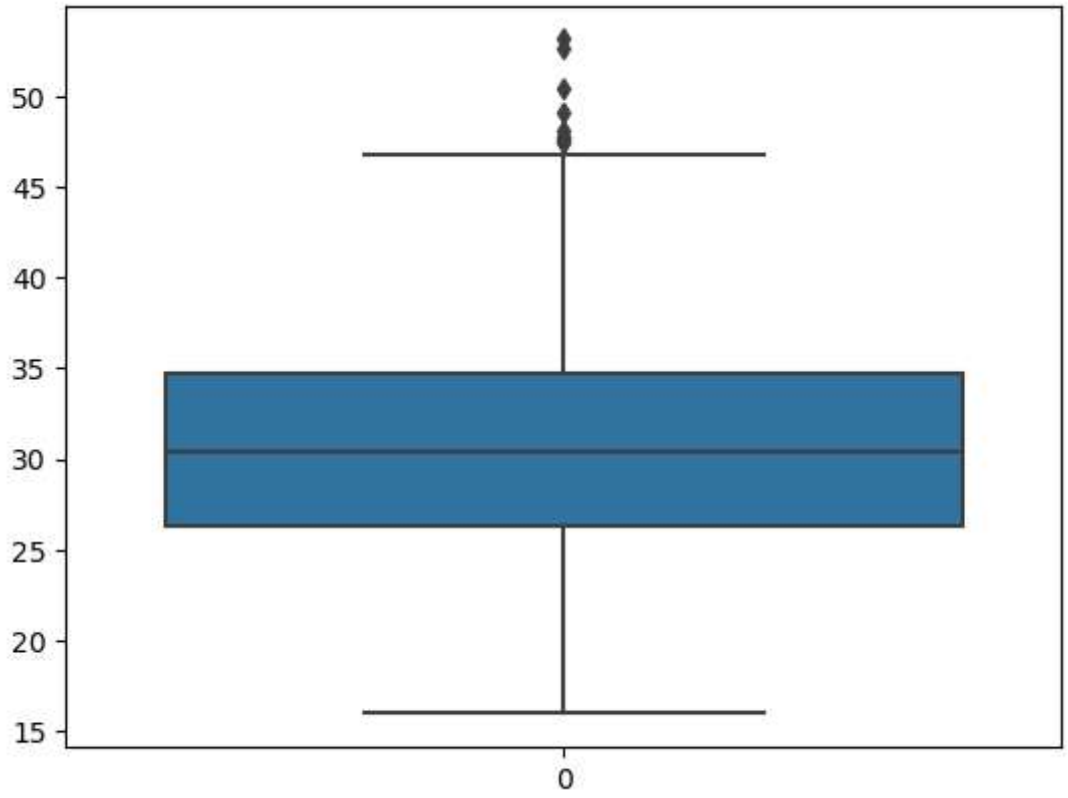
In [7]:
```
df.describe()
```

Out[7]:

	age	sex	bmi	children	smoker	region	charg
count	1338.000000	1338.000000	1338.000000	1338.000000	1338.000000	1338.000000	1338.0000
mean	39.207025	0.505232	30.663397	1.094918	0.204783	1.515695	13270.4222
std	14.049960	0.500160	6.098187	1.205493	0.403694	1.104885	12110.0112
min	18.000000	0.000000	15.960000	0.000000	0.000000	0.000000	1121.8739
25%	27.000000	0.000000	26.296250	0.000000	0.000000	1.000000	4740.2871
50%	39.000000	1.000000	30.400000	1.000000	0.000000	2.000000	9382.0330
75%	51.000000	1.000000	34.693750	2.000000	0.000000	2.000000	16639.9125
max	64.000000	1.000000	53.130000	5.000000	1.000000	3.000000	63770.4280

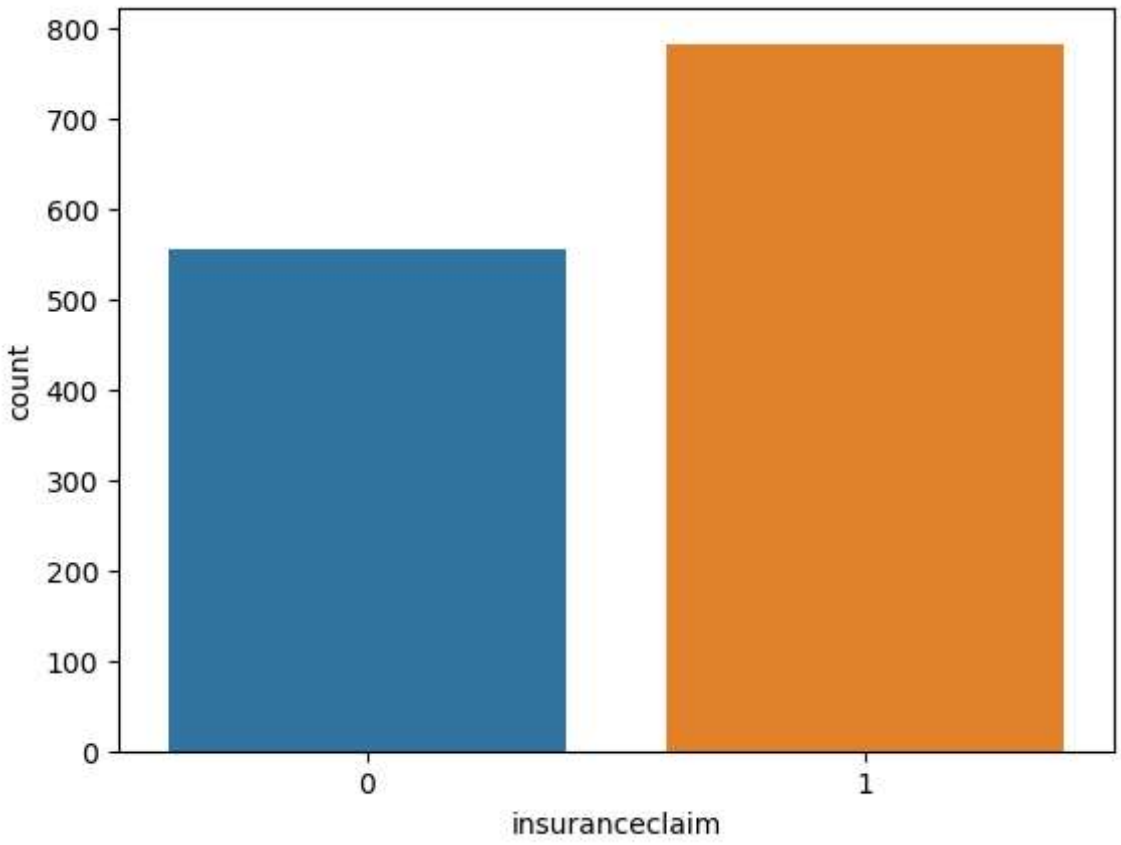
In [8]:
```
sns.boxplot(df["bmi"])
```

Out[8]:
```
<Axes: >
```



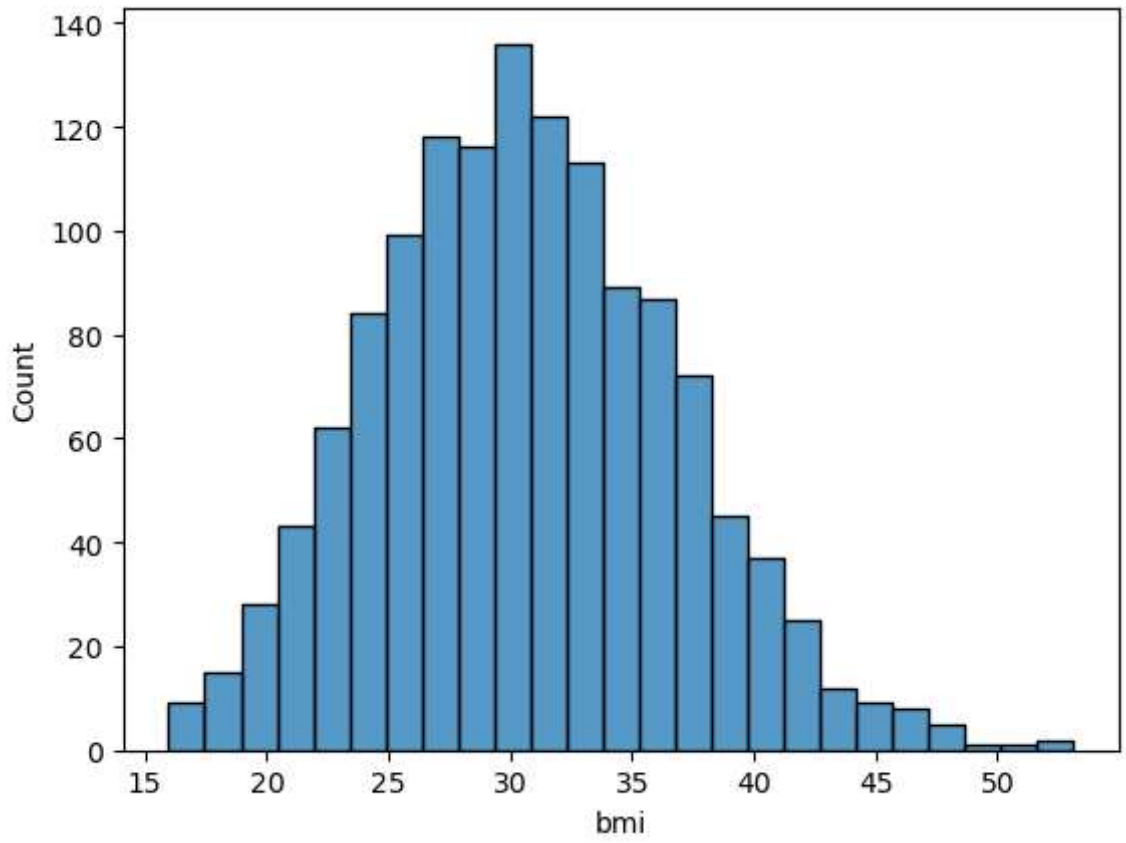
In [9]:
```
sns.countplot(x=df["insuranceclaim"])
```

Out[9]:
```
<Axes: xlabel='insuranceclaim', ylabel='count'>
```



In [10]:
```
sns.histplot(df["bmi"])
```

Out[10]: <Axes: xlabel='bmi', ylabel='Count'>

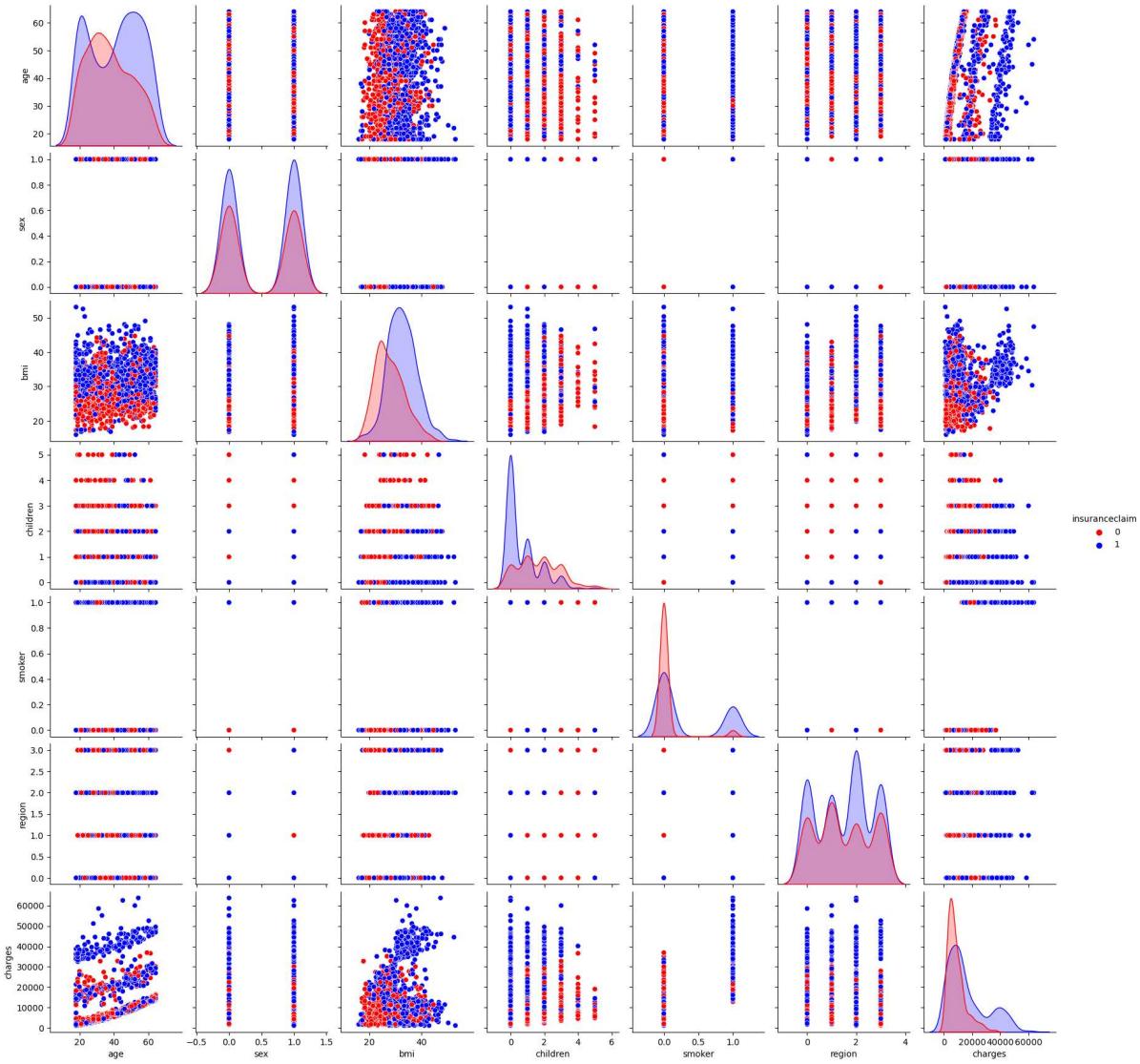


In [11]:
```
plt.figure(figsize=(10,10))
sns.heatmap(df.corr(),annot=True,cmap="crest")
```

Out[11]: <Axes: >

In [12]:
```
import warnings
warnings.filterwarnings("ignore")
custom_palette=["Red","Blue","Violet"]
sns.pairplot(df,hue="insuranceclaim",palette=custom_palette)
```

Out[12]: <seaborn.axisgrid.PairGrid at 0x16a39135c50>



In [13]:
```
q1 = df["bmi"].quantile(0.25) #25 quantile
q2 = df["bmi"].quantile(0.50) #50 quantile
q3 = df["bmi"].quantile(0.75) #75 quantile

#iqr: Inter Quartile Range
iqr = q3-q1

upper_tail = q3 + 1.5 * iqr
lower_tail = q1 - 1.5 * iqr
```

In [14]:
```
upper_tail
```

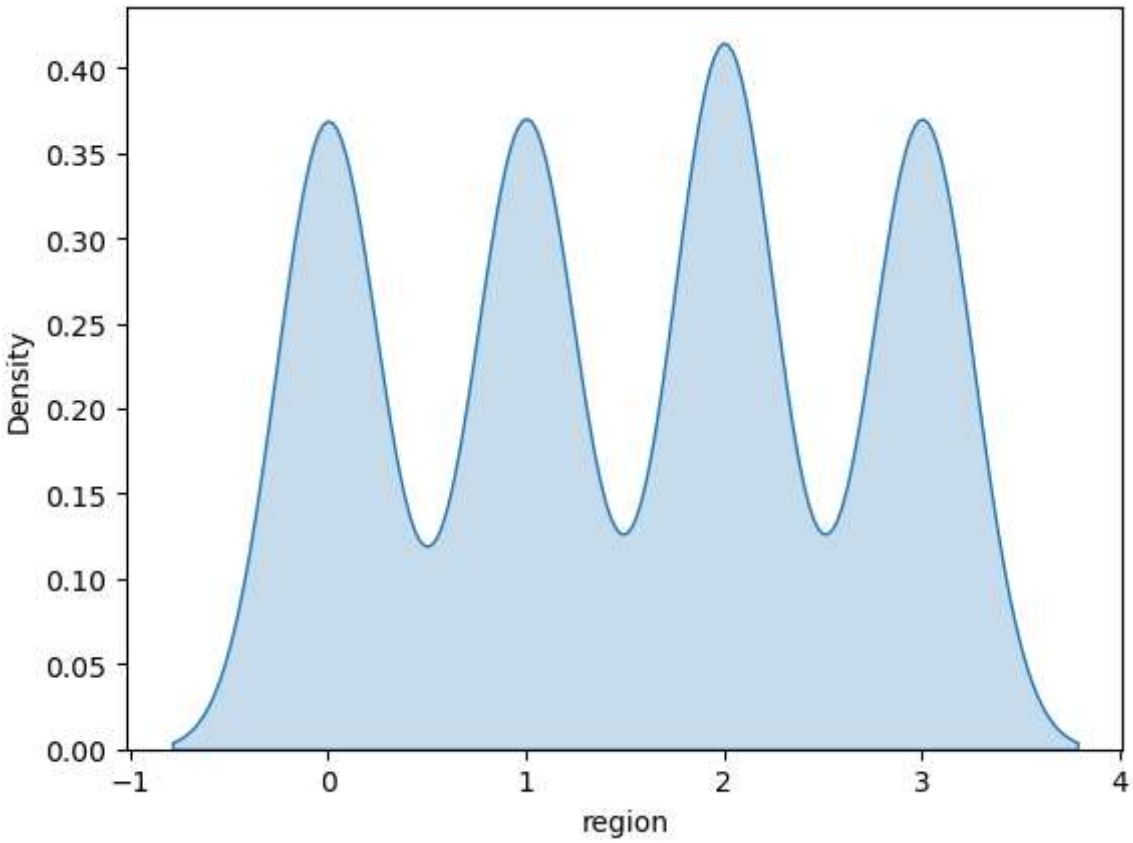
Out[14]: 47.290000000000006

In [15]:
```
lower_tail
```

Out[15]:
```
13.7
```

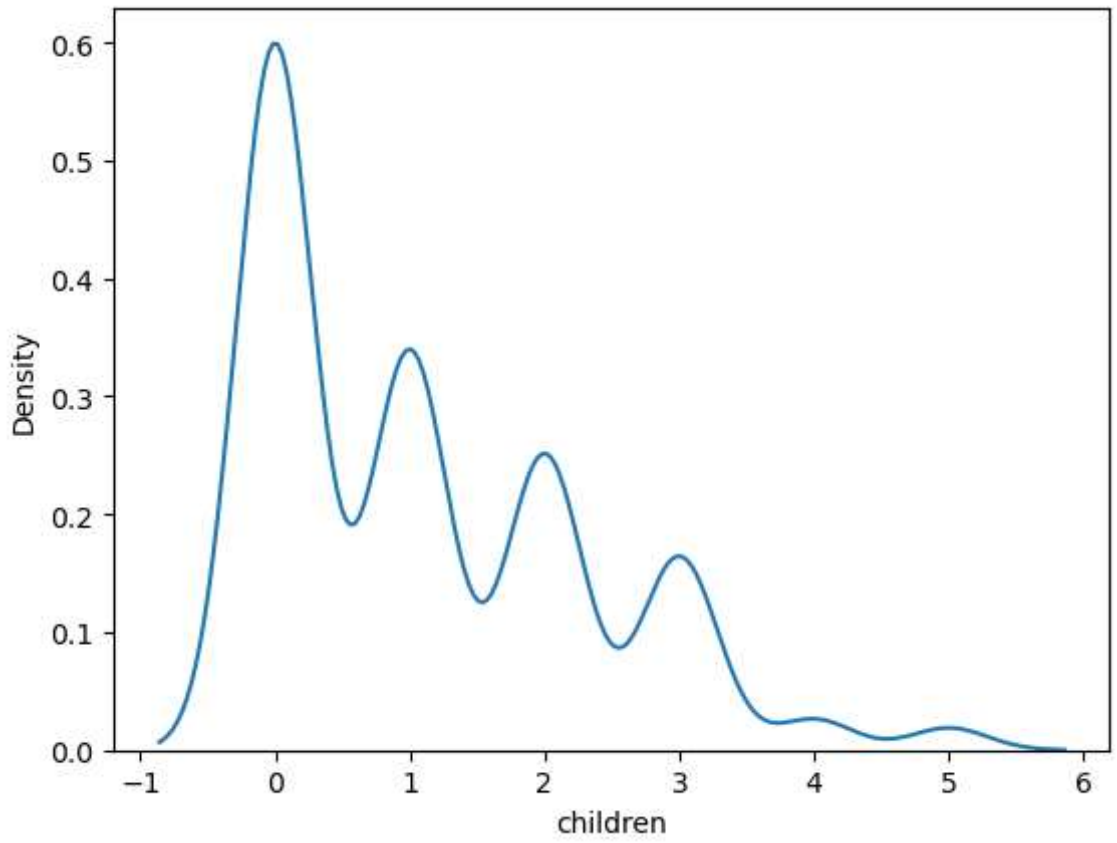
In [16]:
```
sns.kdeplot(df["region"],fill=True)
```

Out[16]:
```
<Axes: xlabel='region', ylabel='Density'>
```



In [17]:
```
sns.kdeplot(df["children"])
```

Out[17]:
```
<Axes: xlabel='children', ylabel='Density'>
```



Checking Outliers(Function)

In [18]:
```
def outliers(n):
    q1=np.percentile(n,25) #25 Quantile
    q2=np.percentile(n,50) #50 Quantile
    q3=np.percentile(n,75) #75 Quantile

    #iqr=Inter Quantile Range
    iqr=q3-q1

    upper_tail = q3 + 1.5 * iqr
    lower_tail = q1 - 1.5 * iqr

    outliers = [i for i in n if i < lower_tail or i > upper_tail]
    return outliers
```

In [19]:
```
n=df["bmi"]
outliers(n)
```

Out[19]:
```
[49.06, 48.07, 47.52, 47.41, 50.38, 47.6, 52.58, 47.74, 53.13]
```

In [20]:
```
df.corr()
```

Out[20]:

	age	sex	bmi	children	smoker	region	charges	insuran
age	1.000000	-0.020856	0.109272	0.042469	-0.025019	0.002127	0.299008	C
sex	-0.020856	1.000000	0.046371	0.017163	0.076185	0.004588	0.057292	C
bmi	0.109272	0.046371	1.000000	0.012759	0.003750	0.157566	0.198341	C
children	0.042469	0.017163	0.012759	1.000000	0.007673	0.016569	0.067998	-C
smoker	-0.025019	0.076185	0.003750	0.007673	1.000000	-0.002181	0.787251	C
region	0.002127	0.004588	0.157566	0.016569	-0.002181	1.000000	-0.006208	C
charges	0.299008	0.057292	0.198341	0.067998	0.787251	-0.006208	1.000000	C
insuranceclaim	0.113723	0.031565	0.384198	-0.409526	0.333261	0.020891	0.309418	1

In [27]:
```
df["insuranceclaim"].unique()
```

Out[27]:
```
array([1, 0], dtype=int64)
```

4: Feature Engineering

Handling Outliers

In [21]:
```
def find_iqr(df,n):
    q1=df[n].quantile(0.25)
    q3=df[n].quantile(0.75)
    iqr=q3-q1
    upper_tail = q3 + 1.5 * iqr
    lower_tail = q1 - 1.5 * iqr
    print(lower_tail)
    print(upper_tail)
    df[n]=df[n].apply(lambda x: upper_tail if x>upper_tail else(lower_tail if x
n="bmi"
find_iqr(df,n)
```

```
13.7
47.290000000000006
```

In [22]:
```
from sklearn.preprocessing import StandardScaler
std = StandardScaler()
std_array = std.fit_transform(df.iloc[:,:7])
df1 = pd.DataFrame(std_array)
df1
```

Out[22]:

	0	1	2	3	4	5	6
0	-1.438764	-1.010519	-0.454201	-0.908614	1.970587	1.343905	0.298584
1	-1.509965	0.989591	0.515300	-0.078767	-0.507463	0.438495	-0.953689
2	-0.797954	0.989591	0.388125	1.580926	-0.507463	0.438495	-0.728675
3	-0.441948	0.989591	-1.312218	-0.908614	-0.507463	-0.466915	0.719843
4	-0.513149	0.989591	-0.292342	-0.908614	-0.507463	-0.466915	-0.776802
...	...	...	...	...	...	...	...
1333	0.768473	0.989591	0.052846	1.580926	-0.507463	-0.466915	-0.220551
1334	-1.509965	-1.010519	0.209750	-0.908614	-0.507463	-1.372326	-0.914002
1335	-1.509965	-1.010519	1.023999	-0.908614	-0.507463	0.438495	-0.961596
1336	-1.296362	-1.010519	-0.801041	-0.908614	-0.507463	1.343905	-0.930362
1337	1.551686	-1.010519	-0.260961	-0.908614	1.970587	-0.466915	1.311053

1338 rows × 7 columns

In [23]:
```
df.shape
```

Out[23]:
```
(1338, 8)
```

In [24]:
```
x=df1
y=df["insuranceclaim"]
x
```

Out[24]:

	0	1	2	3	4	5	6
0	-1.438764	-1.010519	-0.454201	-0.908614	1.970587	1.343905	0.298584
1	-1.509965	0.989591	0.515300	-0.078767	-0.507463	0.438495	-0.953689
2	-0.797954	0.989591	0.388125	1.580926	-0.507463	0.438495	-0.728675
3	-0.441948	0.989591	-1.312218	-0.908614	-0.507463	-0.466915	0.719843
4	-0.513149	0.989591	-0.292342	-0.908614	-0.507463	-0.466915	-0.776802
...	...	...	...	...	...	...	...
1333	0.768473	0.989591	0.052846	1.580926	-0.507463	-0.466915	-0.220551
1334	-1.509965	-1.010519	0.209750	-0.908614	-0.507463	-1.372326	-0.914002
1335	-1.509965	-1.010519	1.023999	-0.908614	-0.507463	0.438495	-0.961596
1336	-1.296362	-1.010519	-0.801041	-0.908614	-0.507463	1.343905	-0.930362
1337	1.551686	-1.010519	-0.260961	-0.908614	1.970587	-0.466915	1.311053

1338 rows × 7 columns

In [25]:
```
y
```

Out[25]:
```
0       1
1       1
2       0
3       0
4       1
       ..
1333    0
1334    1
1335    1
1336    0
1337    1
Name: insuranceclaim, Length: 1338, dtype: int64
```

5: Model Training

In [26]:
```
xtrain,xtest,ytrain,ytest=train_test_split(x,y,test_size=0.2,random_state=10,st
```

In [27]:
```
log_clf=LogisticRegression()
log_clf_model=log_clf.fit(xtrain,ytrain)
log_clf_model
```

Out[27]:
```
LogisticRegression()
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

6: Model Evaluation

In [28]:
```
ytrain_predict=log_clf_model.predict(xtrain)  #training
```

In [29]:
```
accuracy=accuracy_score(ytrain,ytrain_predict)
print(f"Accuracy : {accuracy}")
print("*"*58)

conf_matrix = confusion_matrix(ytrain,ytrain_predict)
print(conf_matrix)
print("*"*58)

class_report = classification_report(ytrain,ytrain_predict)
print(class_report)
print("*"*58)
```

```
Accuracy : 0.8897196261682243
**********************************************************
[[381  63]
 [ 55 571]]
**********************************************************
              precision    recall  f1-score   support

           0       0.87      0.86      0.87       444
           1       0.90      0.91      0.91       626

    accuracy                           0.89      1070
   macro avg       0.89      0.89      0.89      1070
weighted avg       0.89      0.89      0.89      1070

**********************************************************
```

In [31]:
```
ytest_predict=log_clf_model.predict(xtest) #testing
```

In [32]:
```
accuracy=accuracy_score(ytest,ytest_predict)
print(f"Accuracy : {accuracy}")
print("*"*58)

conf_matrix = confusion_matrix(ytest,ytest_predict)
print(conf_matrix)
print("*"*58)

class_report = classification_report(ytest,ytest_predict)
print(class_report)
print("*"*58)
```

```
Accuracy : 0.8768656716417911
**********************************************************
[[ 91  20]
 [ 13 144]]
**********************************************************
              precision    recall  f1-score   support

           0       0.88      0.82      0.85       111
           1       0.88      0.92      0.90       157

    accuracy                           0.88       268
   macro avg       0.88      0.87      0.87       268
weighted avg       0.88      0.88      0.88       268

**********************************************************
```

DECISION TREE

In [38]:
```
dt=DecisionTreeClassifier()
dt
```

Out[38]:
```
DecisionTreeClassifier()
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [40]:
```
dt_model= dt.fit(xtrain,ytrain)
dt_model
```

Out[40]:
```
DecisionTreeClassifier()
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [46]:
```
ytrain_predict1 = dt_model.predict(xtrain)  #training
```

In [49]:
```
accuracy=accuracy_score(ytrain,ytrain_predict1)
print(f"Accuracy : {accuracy}")
print("*"*58)

conf_matrix = confusion_matrix(ytrain,ytrain_predict1)
print(conf_matrix)
print("*"*58)

class_report = classification_report(ytrain,ytrain_predict1)
print(class_report)
print("*"*58)
```

```
Accuracy : 1.0
**********************************************************
[[444   0]
 [  0 626]]
**********************************************************
              precision    recall  f1-score   support

           0       1.00      1.00      1.00       444
           1       1.00      1.00      1.00       626

    accuracy                           1.00      1070
   macro avg       1.00      1.00      1.00      1070
weighted avg       1.00      1.00      1.00      1070

**********************************************************
```

In [50]:
```
ytest_predict1=dt_model.predict(xtrain)   #testing
```

In [51]:
```
accuracy = accuracy_score(ytest,ytest_predict1)
print(f"Accuracy : {accuracy}")
print("*"*55)

conf_matrix = confusion_matrix(ytest,ytest_predict1)
print(conf_matrix)
print("*"*55)

class_report = classification_report(ytest,ytest_predict1)
print(class_report)
print("*"*55)
```

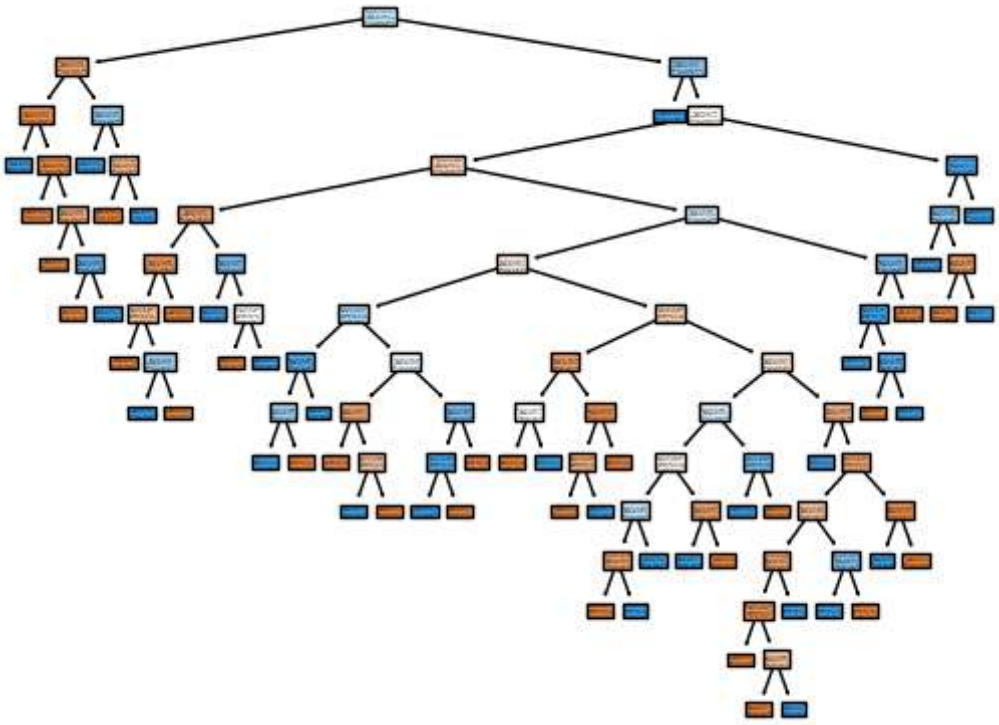
```
Accuracy : 0.9514925373134329
*******************************************************
[[103   8]
 [  5 152]]
*******************************************************
              precision    recall  f1-score   support

           0       0.95      0.93      0.94       111
           1       0.95      0.97      0.96       157

    accuracy                           0.95       268
   macro avg       0.95      0.95      0.95       268
weighted avg       0.95      0.95      0.95       268

*******************************************************
```

In [52]:
```
dt
```

Out[52]:
```
DecisionTreeClassifier()
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [54]:
```
dt_plot = plot_tree(dt_model,class_names=["Yes","No"], filled = True)
```



DECISION TREE PARAMETERS

In [55]:
```
hyperparameters={"criterion":["entropy","gini"],
                 "max_depth":np.arange(1,10),
                 "min_samples_split":np.arange(2,10),
                 "min_samples_leaf":np.arange(2,10),}
```

In [59]:
```
random_search_model=RandomizedSearchCV(dt_model,hyperparameters,error_score="ra
random_search_model
```

Out[59]:
```
RandomizedSearchCV(cv=5, error_score='raise',
                   estimator=DecisionTreeClassifier(),
                   param_distributions={'criterion': ['entropy', 'gini'],
                                        'max_depth': array([1, 2, 3, 4, 5, 6,
7, 8, 9]),
                                        'min_samples_leaf': array([2, 3, 4,
5, 6, 7, 8, 9]),
                                        'min_samples_split': array([2, 3, 4,
5, 6, 7, 8, 9])})
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [60]:
```
random_search_model.fit(xtrain,ytrain)
```

Out[60]:
```
RandomizedSearchCV(cv=5, error_score='raise',
                   estimator=DecisionTreeClassifier(),
                   param_distributions={'criterion': ['entropy', 'gini'],
                                        'max_depth': array([1, 2, 3, 4, 5, 6,
7, 8, 9]),
                                        'min_samples_leaf': array([2, 3, 4,
5, 6, 7, 8, 9]),
                                        'min_samples_split': array([2, 3, 4,
5, 6, 7, 8, 9])})
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [62]:
```
random_search_model.best_estimator_
```

Out[62]:
```
DecisionTreeClassifier(criterion='entropy', max_depth=9, min_samples_leaf=5,
                       min_samples_split=5)
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [63]:
```
hyp_dt_model = DecisionTreeClassifier(criterion='entropy', max_depth=3, min_sam
```

In [64]:
```
hyp_dt_model.fit(xtrain,ytrain)
```

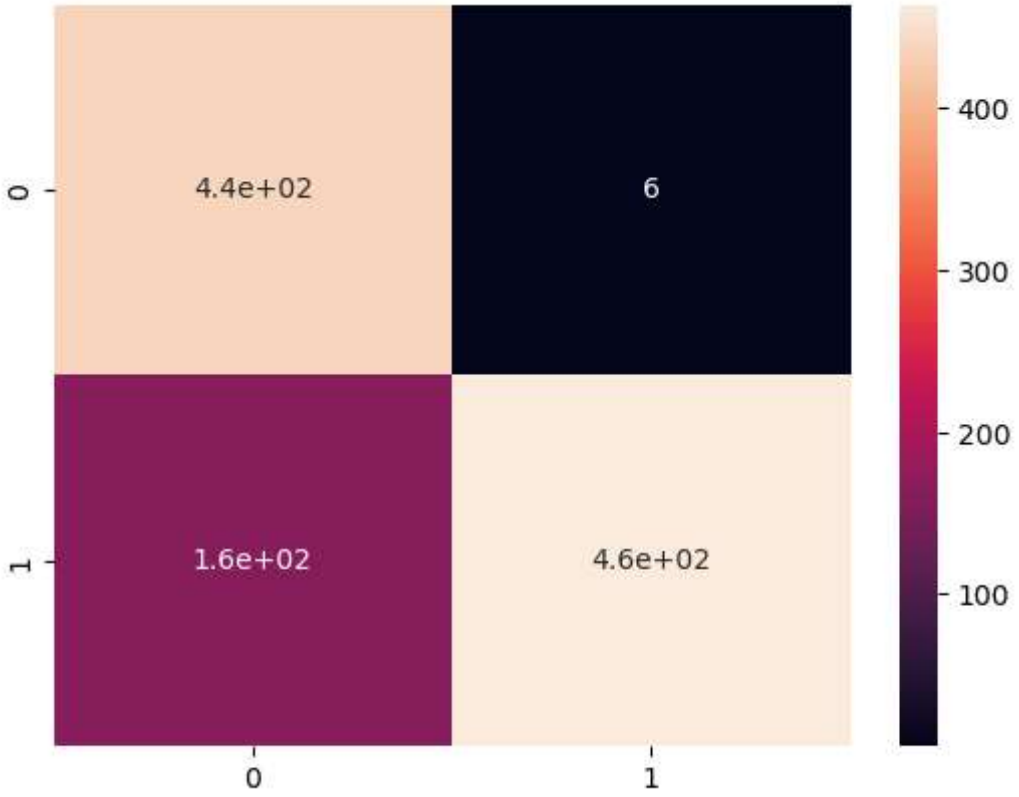
Out[64]:
```
DecisionTreeClassifier(criterion='entropy', max_depth=3, min_samples_leaf=13)
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [73]:
```
ypred_train = hyp_dt_model.predict(xtrain)
```

In [74]:
```
print(f"Accuracy = {accuracy_score(ytrain,ypred_train)}")              #TESTING
print(classification_report(ytrain,ypred_train))
print(sns.heatmap(confusion_matrix(ytrain,ypred_train),annot=True))
```

```
Accuracy = 0.8429906542056075
              precision    recall  f1-score   support

           0       0.73      0.99      0.84       444
           1       0.99      0.74      0.85       626

    accuracy                           0.84      1070
   macro avg       0.86      0.86      0.84      1070
weighted avg       0.88      0.84      0.84      1070

Axes(0.125,0.11;0.62x0.77)
```



In [75]:
```
ypred_test = hyp_dt_model.predict(xtest)
```

In [76]:
```
print(f"Accuracy = {accuracy_score(ytest,ypred_test)}")
print(confusion_matrix(ytest,ypred_test))
print(classification_report(ypred_test,ytest))
```

```
Accuracy = 0.8432835820895522
[[110   1]
 [ 41 116]]
              precision    recall  f1-score   support

           0       0.99      0.73      0.84       151
           1       0.74      0.99      0.85       117

    accuracy                           0.84       268
   macro avg       0.86      0.86      0.84       268
weighted avg       0.88      0.84      0.84       268
```

RANDOM FOREST

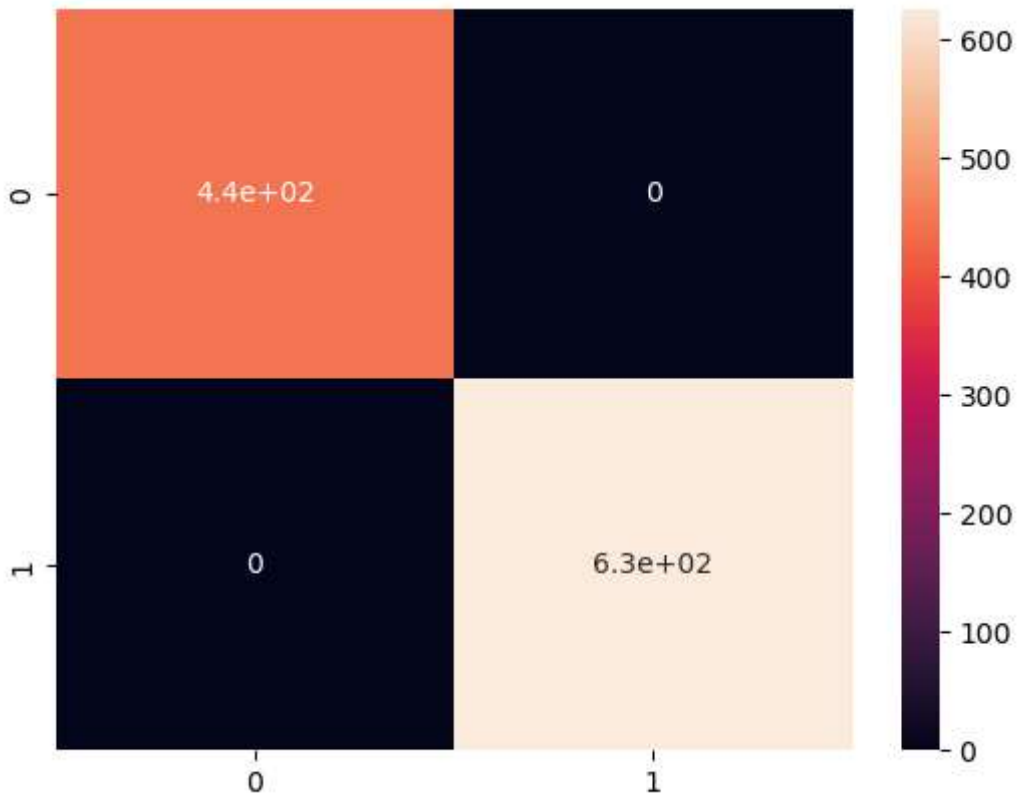
In [77]:
```
rf_clf = RandomForestClassifier()
```

In [80]:
```
rf_clf_model = rf_clf.fit(xtrain,ytrain)
```

In [83]:
```
ypred_train1 = rf_clf_model.predict(xtrain)
```

In [84]:
```
print("Accuracy = ",accuracy_score(ytrain,ypred_train1))                #TRAINING
sns.heatmap(confusion_matrix(ytrain,ypred_train1),annot=True)
print(classification_report(ytrain,ypred_train1))
```

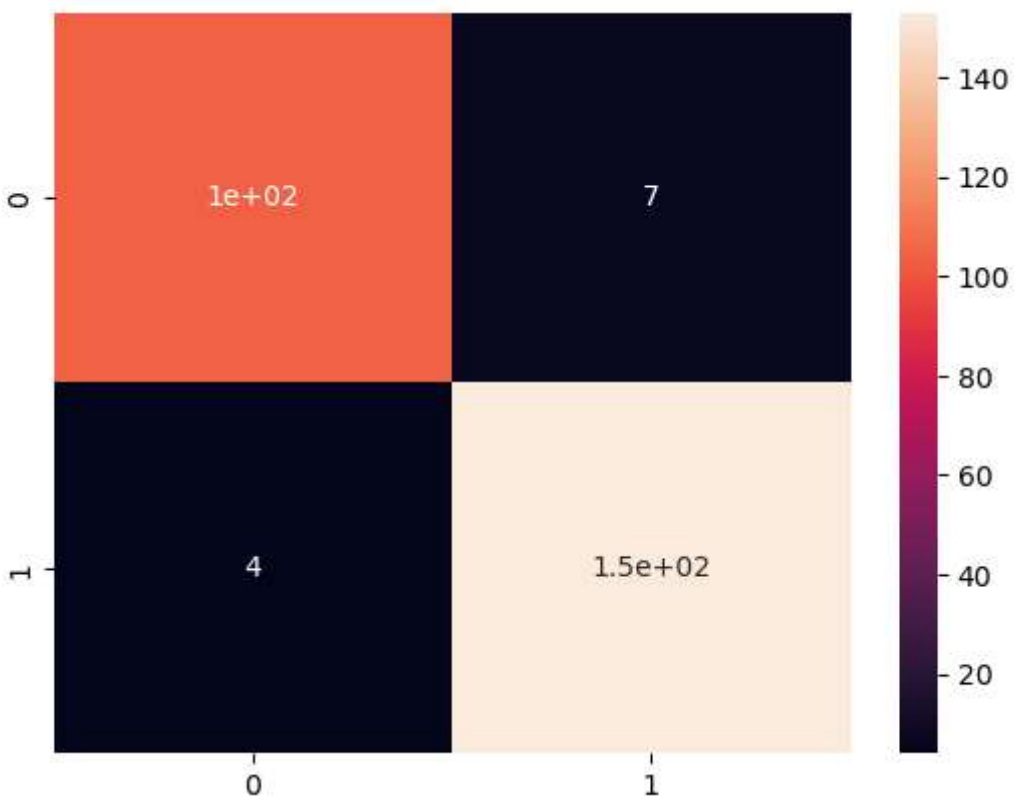
```
Accuracy =  1.0
              precision    recall  f1-score   support

           0       1.00      1.00      1.00       444
           1       1.00      1.00      1.00       626

    accuracy                           1.00      1070
   macro avg       1.00      1.00      1.00      1070
weighted avg       1.00      1.00      1.00      1070
```



In [85]:
```
ypred_test1 = rf_clf_model.predict(xtest)
```

In [86]:
```
print(f"Accuracy = {accuracy_score(ytest,ypred_test1)}")          #TESTING
sns.heatmap(confusion_matrix(ytest,ypred_test1),annot=True)
print(classification_report(ytest,ypred_test1))
```

```
Accuracy = 0.9589552238805971
              precision    recall  f1-score   support

           0       0.96      0.94      0.95       111
           1       0.96      0.97      0.97       157

    accuracy                           0.96       268
   macro avg       0.96      0.96      0.96       268
weighted avg       0.96      0.96      0.96       268
```



RANDOM FOREST PARAMETERS

In [87]:
```
hyp={
   "n_estimators":np.arange(10,200),
    "criterion": ['gini','entropy'],
    "max_depth" : np.arange(5,15),
    "min_samples_split":np.arange(5,20),
    "min_samples_leaf":np.arange(4,15),
    "max_features":['auto']
}
```

In [88]:
```
rscv_rf_clf = RandomizedSearchCV(rf_clf_model, hyp, cv = 6)
```

In [91]:
```
rscv_rf_clf.fit(xtrain,ytrain)
```

Out[91]:
```
RandomizedSearchCV(cv=6, estimator=RandomForestClassifier(),
                   param_distributions={'criterion': ['gini', 'entropy'],
                                        'max_depth': array([ 5,  6,  7,  8,
9, 10, 11, 12, 13, 14]),
                                        'max_features': ['auto'],
                                        'min_samples_leaf': array([ 4,  5,
6,  7,  8,  9, 10, 11, 12, 13, 14]),
                                        'min_samples_split': array([ 5,  6,
7,  8,  9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19]),
                                        'n_estimators': array([ 10,  11,  12,
13,  14,  15,  16,  17...
       101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113,
       114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126,
       127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139,
       140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152,
       153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165,
       166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178,
       179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191,
       192, 193, 194, 195, 196, 197, 198, 199])})
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [92]:
```
rscv_rf_clf.best_estimator_
```

Out[92]:
```
RandomForestClassifier(criterion='entropy', max_depth=14, max_features='aut
o',
                       min_samples_leaf=4, min_samples_split=12,
                       n_estimators=128)
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [93]:
```
rf_clf = RandomForestClassifier(criterion='entropy', max_depth=13, max_features
                        min_samples_leaf=10, min_samples_split=7,
                        n_estimators=135, random_state=10)
rf_clf
```

Out[93]:
```
RandomForestClassifier(criterion='entropy', max_depth=13, max_features='aut
o',
                       min_samples_leaf=10, min_samples_split=7,
                       n_estimators=135, random_state=10)
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [94]:
```
rf_clf.fit(xtrain,ytrain)
```

Out[94]:
```
RandomForestClassifier(criterion='entropy', max_depth=13, max_features='aut
o',
                       min_samples_leaf=10, min_samples_split=7,
                       n_estimators=135, random_state=10)
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [95]:
```
y_pred_train = rf_clf.predict(xtrain)
```

In [96]:
```
accuracy = accuracy_score(ytrain,y_pred_train)                    #TRAINING
print(f"Accuracy : {accuracy}")
conf_matrix = confusion_matrix(ytrain,y_pred_train)
print(conf_matrix)
class_report = classification_report(ytrain,y_pred_train)
print(class_report)
```

```
Accuracy : 0.9672897196261683
[[428  16]
 [ 19 607]]
              precision    recall  f1-score   support

           0       0.96      0.96      0.96       444
           1       0.97      0.97      0.97       626

    accuracy                           0.97      1070
   macro avg       0.97      0.97      0.97      1070
weighted avg       0.97      0.97      0.97      1070
```

In [97]:
```
y_pred_test = rf_clf.predict(xtest)
```

In [98]:
```
accuracy = accuracy_score(ytest,y_pred_test)            #TESTING
print(f"Accuracy : {accuracy}")
conf_matrix = confusion_matrix(ytest,y_pred_test)
print(conf_matrix)
class_report = classification_report(ytest,y_pred_test)
print(class_report)
```

```
Accuracy : 0.9402985074626866
[[101  10]
 [  6 151]]
              precision    recall  f1-score   support

           0       0.94      0.91      0.93       111
           1       0.94      0.96      0.95       157

    accuracy                           0.94       268
   macro avg       0.94      0.94      0.94       268
weighted avg       0.94      0.94      0.94       268
```

ADABOOST

In [103]:
```
adb_clf = AdaBoostClassifier()
adb_clf
```

Out[103]:
```
AdaBoostClassifier()
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [104]:
```
adb_clf_model = adb_clf.fit(xtrain,ytrain)
adb_clf_model
```

Out[104]:
```
AdaBoostClassifier()
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [105]:
```
ypred__train1 = adb_clf_model.predict(xtrain)
```

In [108]:
```
accuracy = accuracy_score(ytrain,ypred__train1)           #TRAINING
print(f"Accuracy : {accuracy}")

conf_matrix = confusion_matrix(ytrain,ypred__train1)
print(conf_matrix)

class_report = classification_report(ytrain,ypred__train1)
print(class_report)
```

```
Accuracy : 0.8897196261682243
[[384  60]
 [ 58 568]]
              precision    recall  f1-score   support

           0       0.87      0.86      0.87       444
           1       0.90      0.91      0.91       626

    accuracy                           0.89      1070
   macro avg       0.89      0.89      0.89      1070
weighted avg       0.89      0.89      0.89      1070
```

In [107]:
```
ypred__test1 = adb_clf_model.predict(xtest)
```

In [109]:
```
accuracy = accuracy_score(ytest,ypred__test1)           #TRAINING
print(f"Accuracy : {accuracy}")

conf_matrix = confusion_matrix(ytest,ypred__test1)
print(conf_matrix)

class_report = classification_report(ytest,ypred__test1)
print(class_report)
```

```
Accuracy : 0.8283582089552238
[[ 84  27]
 [ 19 138]]
              precision    recall  f1-score   support

           0       0.82      0.76      0.79       111
           1       0.84      0.88      0.86       157

    accuracy                           0.83       268
   macro avg       0.83      0.82      0.82       268
weighted avg       0.83      0.83      0.83       268
```

ADABOOST HYPERPARAMETERS

In [112]:
```
hyp = {"n_estimators":np.arange(10,200),
       "max_depth": [None, 10, 20, 30]}

rscv_adb_clf_model = RandomizedSearchCV(rf_clf_model, hyp, cv = 6)
rscv_adb_clf_model.fit(xtrain,ytrain)
rscv_adb_clf_model.best_estimator_
```

Out[112]:
```
RandomForestClassifier(max_depth=30, n_estimators=51)
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [120]:
```
adb_clf = AdaBoostClassifier(learning_rate=0.1, n_estimators=36, random_state=1
adb_clf
```

Out[120]:
```
AdaBoostClassifier(learning_rate=0.1, n_estimators=36, random_state=10)
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [121]:
```
adb_clf.fit(xtrain,ytrain)
```

Out[121]:
```
AdaBoostClassifier(learning_rate=0.1, n_estimators=36, random_state=10)
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [122]:
```
y_pred__train = adb_clf.predict(xtrain)
```

In [124]:
```
accuracy = accuracy_score(ytrain,y_pred__train)        #TRAINING
print(f"Accuracy : {accuracy}")

conf_matrix = confusion_matrix(ytrain,y_pred__train)
print(conf_matrix)

class_report = classification_report(ytrain,y_pred__train)
print(class_report)
```

```
Accuracy : 0.8411214953271028
[[334 110]
 [ 60 566]]
              precision    recall  f1-score   support

           0       0.85      0.75      0.80       444
           1       0.84      0.90      0.87       626

    accuracy                           0.84      1070
   macro avg       0.84      0.83      0.83      1070
weighted avg       0.84      0.84      0.84      1070
```

In [125]:
```
y_pred__test = adb_clf.predict(xtest)
```

In [128]:
```
accuracy = accuracy_score(ytest,y_pred__test)         #TESTING
print(f"Accuracy : {accuracy}")

conf_matrix = confusion_matrix(ytest,y_pred__test)
print(conf_matrix)

class_report = classification_report(ytest,y_pred__test)
print(class_report)
```

```
Accuracy : 0.7910447761194029
[[ 72  39]
 [ 17 140]]
              precision    recall  f1-score   support

           0       0.81      0.65      0.72       111
           1       0.78      0.89      0.83       157

    accuracy                           0.79       268
   macro avg       0.80      0.77      0.78       268
weighted avg       0.79      0.79      0.79       268
```

In [ ]: