problem Statement:To predict How Best the data fits

1)Data Collection

In [1]:

```python
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn import preprocessing,svm
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
```

In [2]:

```python
df=pd.read_csv(r"C:\Users\chinta pavani\Documents\insurance.csv")
df
```

Out[2]:

	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
...	...	...	...	...	...	...	...
1333	50	male	30.970	3	no	northwest	10600.54830
1334	18	female	31.920	0	no	northeast	2205.98080
1335	18	female	36.850	0	no	southeast	1629.83350
1336	21	female	25.800	0	no	southwest	2007.94500
1337	61	female	29.070	0	yes	northwest	29141.36030

1338 rows × 7 columns

2)Data Cleaning and Preprocessing

In [3]:
```
df.head()
```

Out[3]:

	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 [4]:
```
df.tail()
```

Out[4]:

	age	sex	bmi	children	smoker	region	charges
1333	50	male	30.97	3	no	northwest	10600.5483
1334	18	female	31.92	0	no	northeast	2205.9808
1335	18	female	36.85	0	no	southeast	1629.8335
1336	21	female	25.80	0	no	southwest	2007.9450
1337	61	female	29.07	0	yes	northwest	29141.3603

In [5]:
```
df.shape
```

Out[5]:
```
(1338, 7)
```

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

Out[6]:
```
<bound method NDFrame.describe of       age     sex     bmi  children smo
ker     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
...   ...     ...     ...       ...    ...        ...          ...
1333   50    male  30.970         3     no  northwest  10600.54830
1334   18  female  31.920         0     no  northeast   2205.98080
1335   18  female  36.850         0     no  southeast   1629.83350
1336   21  female  25.800         0     no  southwest   2007.94500
1337   61  female  29.070         0    yes  northwest  29141.36030

[1338 rows x 7 columns]>
```

In [7]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1338 entries, 0 to 1337
Data columns (total 7 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       1338 non-null   int64  
 1   sex       1338 non-null   object 
 2   bmi       1338 non-null   float64
 3   children  1338 non-null   int64  
 4   smoker    1338 non-null   object 
 5   region    1338 non-null   object 
 6   charges   1338 non-null   float64
dtypes: float64(2), int64(2), object(3)
memory usage: 73.3+ KB
```

In [8]:

```
df.isnull().any()
```

Out[8]:

```
age         False
sex         False
bmi         False
children    False
smoker      False
region      False
charges     False
dtype: bool
```

In [9]:

```
df.isna().sum()
```

Out[9]:

```
age         0
sex         0
bmi         0
children    0
smoker      0
region      0
charges     0
dtype: int64
```

In [10]:

```
df['region'].value_counts()
```

Out[10]:

```
region
southeast    364
southwest    325
northwest    325
northeast    324
Name: count, dtype: int64
```

In [11]:

```
convert={"sex":{"female":1,"male":0}}
df=df.replace(convert)
df
```

Out[11]:

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

In [12]:

```
convert={"smoker":{"yes":1, "no":0}}
df=df.replace(convert)
df
```

Out[12]:

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

1338 rows × 7 columns

In [13]:

```
convert={"region":{"southwest":1, "southeast":2,"northwest":3,"northeast":
df=df.replace(convert)
df
```

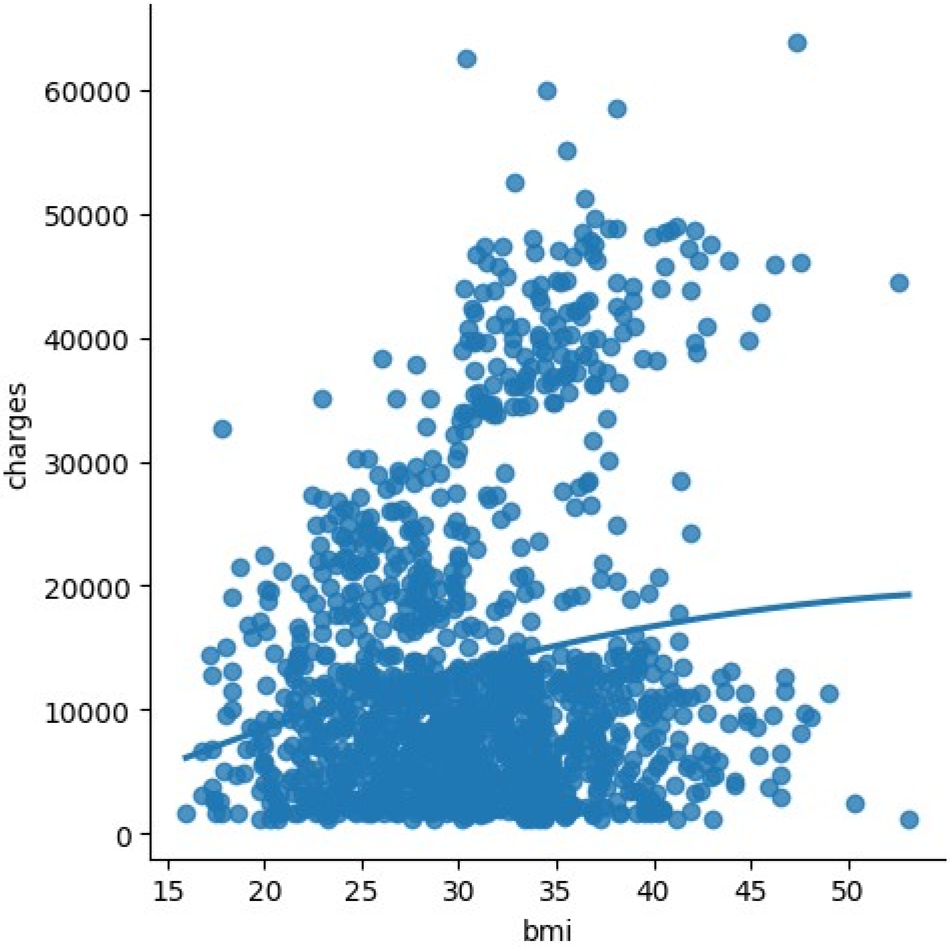
Out[13]:

```
      age  sex     bmi  children  smoker  region      charges
0      19    1  27.900         0       1       1  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       3  21984.47061
4      32    0  28.880         0       0       3   3866.85520
...   ...  ...     ...       ...     ...     ...          ...
1333   50    0  30.970         3       0       3  10600.54830
1334   18    1  31.920         0       0       4   2205.98080
1335   18    1  36.850         0       0       2   1629.83350
1336   21    1  25.800         0       0       1   2007.94500
1337   61    1  29.070         0       1       3  29141.36030

1338 rows × 7 columns
```

3)Data Visualization

In [14]:
```
sns.lmplot(x='bmi',y='charges',order=2,data=df,ci=None)
plt.show()
```



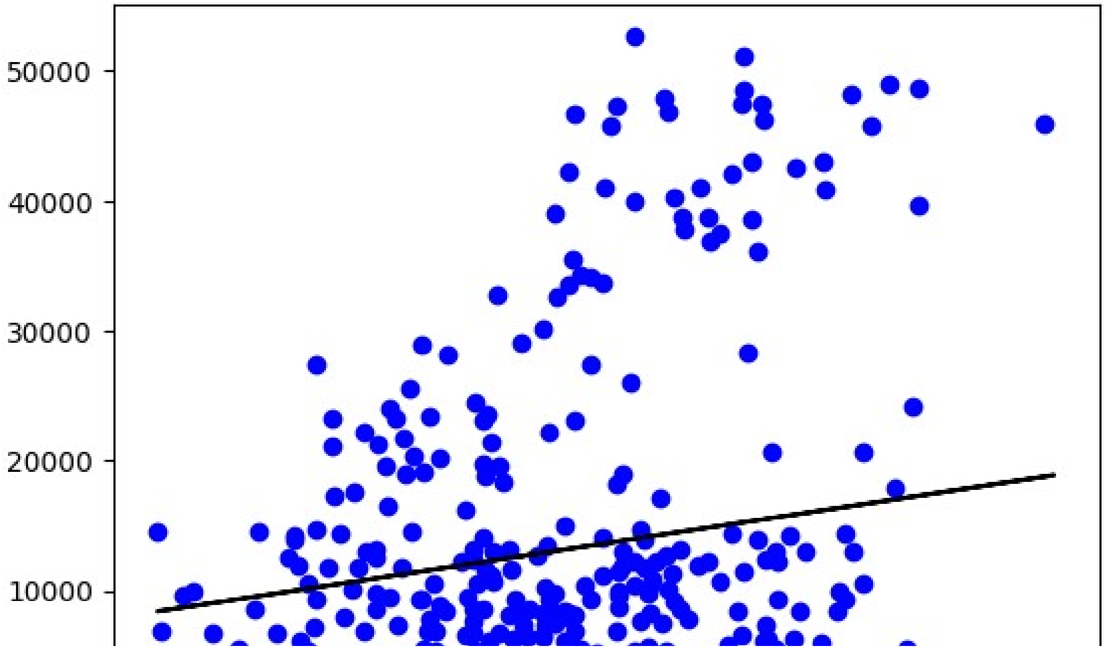
In [15]:
```
x=np.array(df['bmi']).reshape(-1,1)
y=np.array(df['charges']).reshape(-1,1)
```

In [16]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.25,random_s
lr=LinearRegression()
lr.fit(x_train,y_train)
print(lr.score(x_test,y_test))
```

```
0.050136213258239914
```

In [17]:

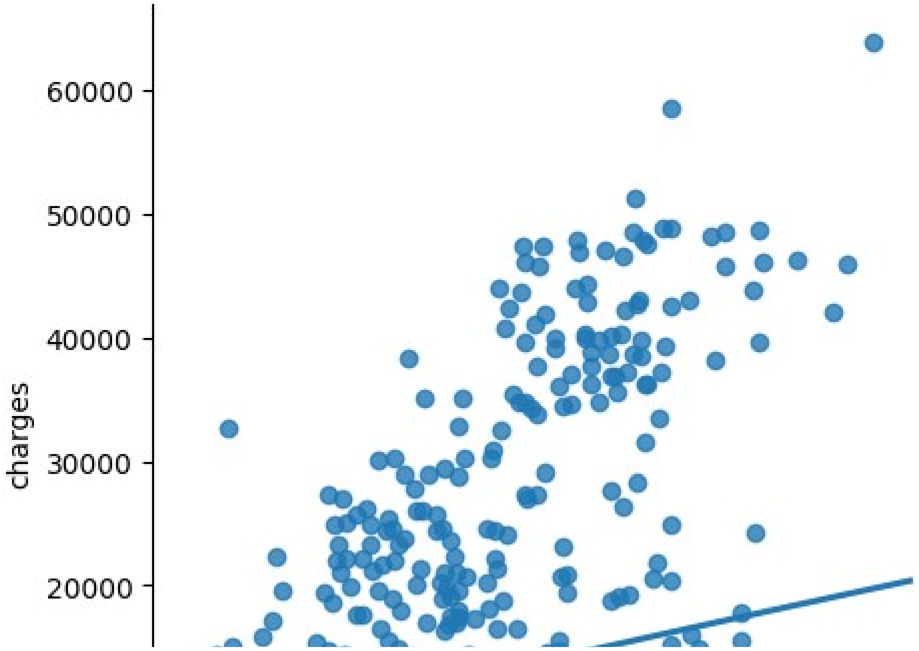
```
y_pred=lr.predict(x_test)
plt.scatter(x_test,y_test,color='b')
plt.plot(x_test,y_pred,color='k')
plt.show()
```



Working With Subset Of Data

In [18]:

```
df700=df[:][:700]
sns.lmplot(x="bmi",y="charges",order=2,ci=None,data=df700)
plt.show()
```



In [19]:

```
df700.fillna(method='ffill',inplace=True)
```

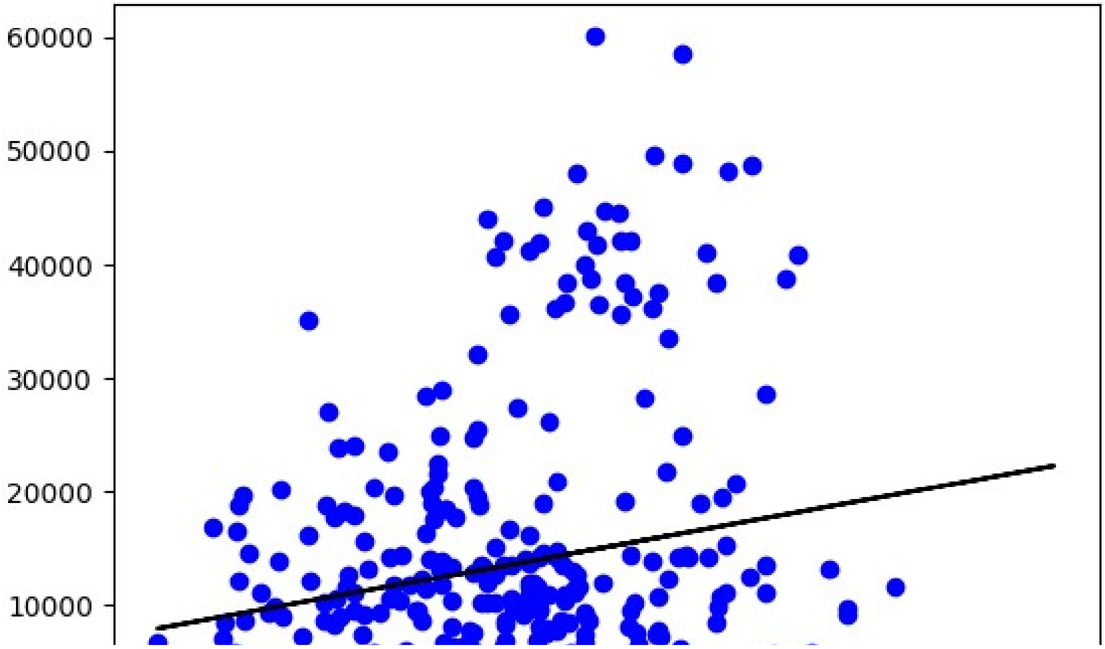
In [20]:
```
x=np.array(df['bmi']).reshape(-1,1)
y=np.array(df['charges']).reshape(-1,1)
```

In [21]:
```
df700.dropna(inplace=True)
```

In [22]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.25)
lr=LinearRegression()
lr.fit(x_train,y_train)
print(lr.score(x_test,y_test))
```

```
0.03834819458441918
```

In [23]:
```
y_pred=lr.predict(x_test)
plt.scatter(x_test,y_test,color='b')
plt.plot(x_test,y_pred,color='k')
plt.show()
```



Evaluation of model

In [24]:
```
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score
lr=LinearRegression()
lr.fit(x_train,y_train)
y_pred=lr.predict(x_test)
r2=r2_score(y_test,y_pred)
print(r2)
```

```
0.03834819458441918
```

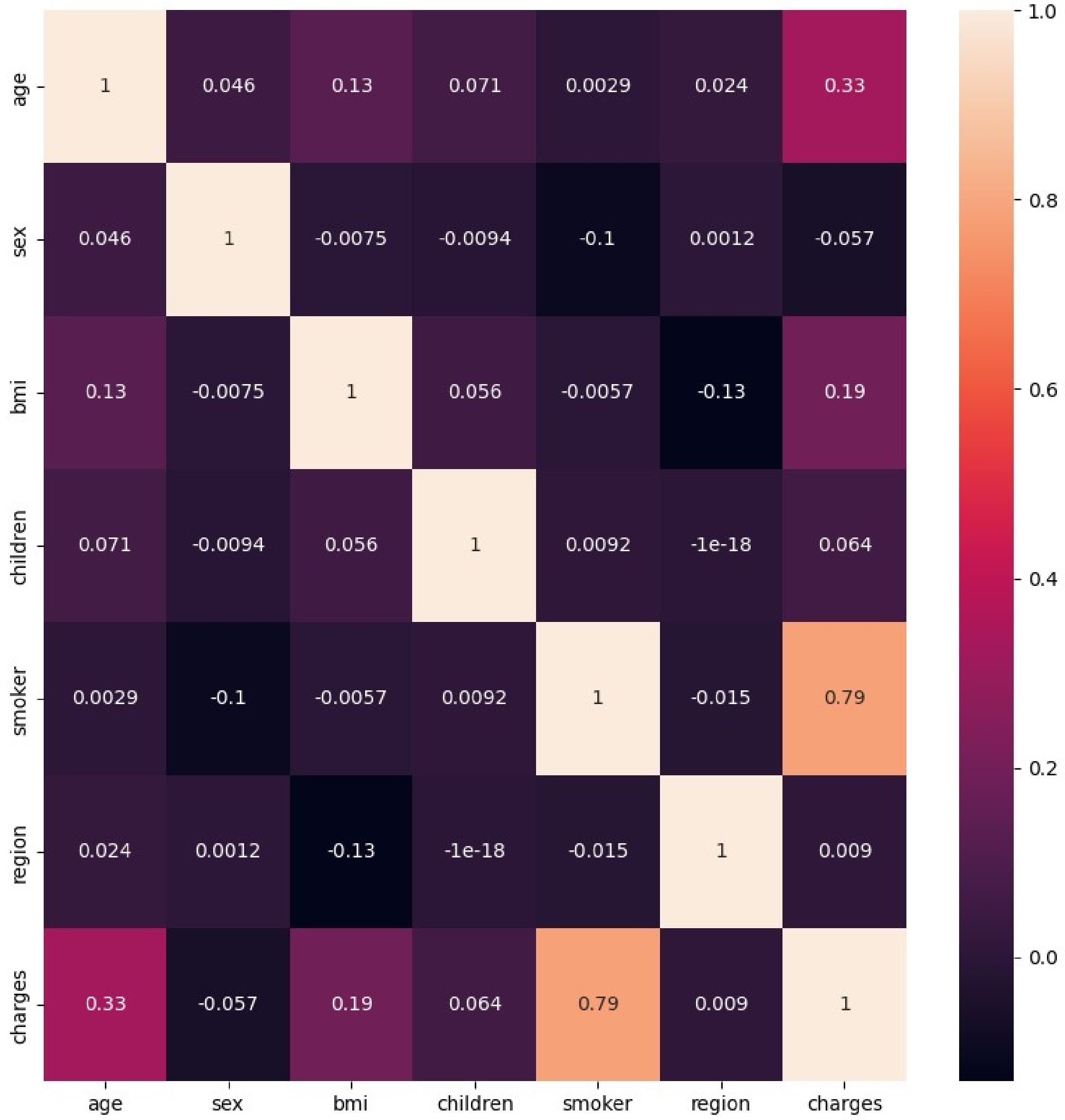
Ridge Regression

In [25]:

```
from sklearn.linear_model import Lasso,Ridge
from sklearn.preprocessing import StandardScaler
```

In [26]:

```
plt.figure(figsize= (10,10))
sns.heatmap(df700.corr(),annot = True)
plt.show()
```



In [27]:

```
features =df.columns[0:1]
target = df.columns[-1]
x = df[features].values
y = df[target].values
x_train,x_test,y_train,y_test = train_test_split(x,y, test_size=0.30,rando
print("The dimension of x_train is {}".format(x_train.shape))
print("The dimension of x_test is {}".format(x_test.shape))
```

```
The dimension of x_train is (936, 1)
The dimension of x_test is (402, 1)
```

In [28]:

```
lr = LinearRegression()
#Fit model
lr.fit(x_train,y_train)
#Predict
#Prediction =Lr.predict(x_test)
#actual
actual = y_test
train_score_lr = lr.score(x_train,y_train)
test_score_lr = lr.score(x_test,y_test)
print("\nLinear Regression Model :\n")
print("The train score for lr model is {}".format(train_score_lr))
print("The test score for lr model is {}".format(test_score_lr))
```

```

Linear Regression Model :

The train score for lr model is 0.09109639738057 14
The test score for lr model is 0.08490473916580776
```

In [29]:

```
ridgeReg = Ridge(alpha=10)
ridgeReg.fit(x_train,y_train)
#train and test score for ridge regression
train_score_ridge = ridgeReg.score(x_train,y_train)
test_score_ridge = ridgeReg.score(x_test,y_test)
print("\nRidge Model :\n")
print("The train score for ridge model is {}".format(train_score_ridge))
print("The test score for ridge model is {}".format(test_score_ridge))
```

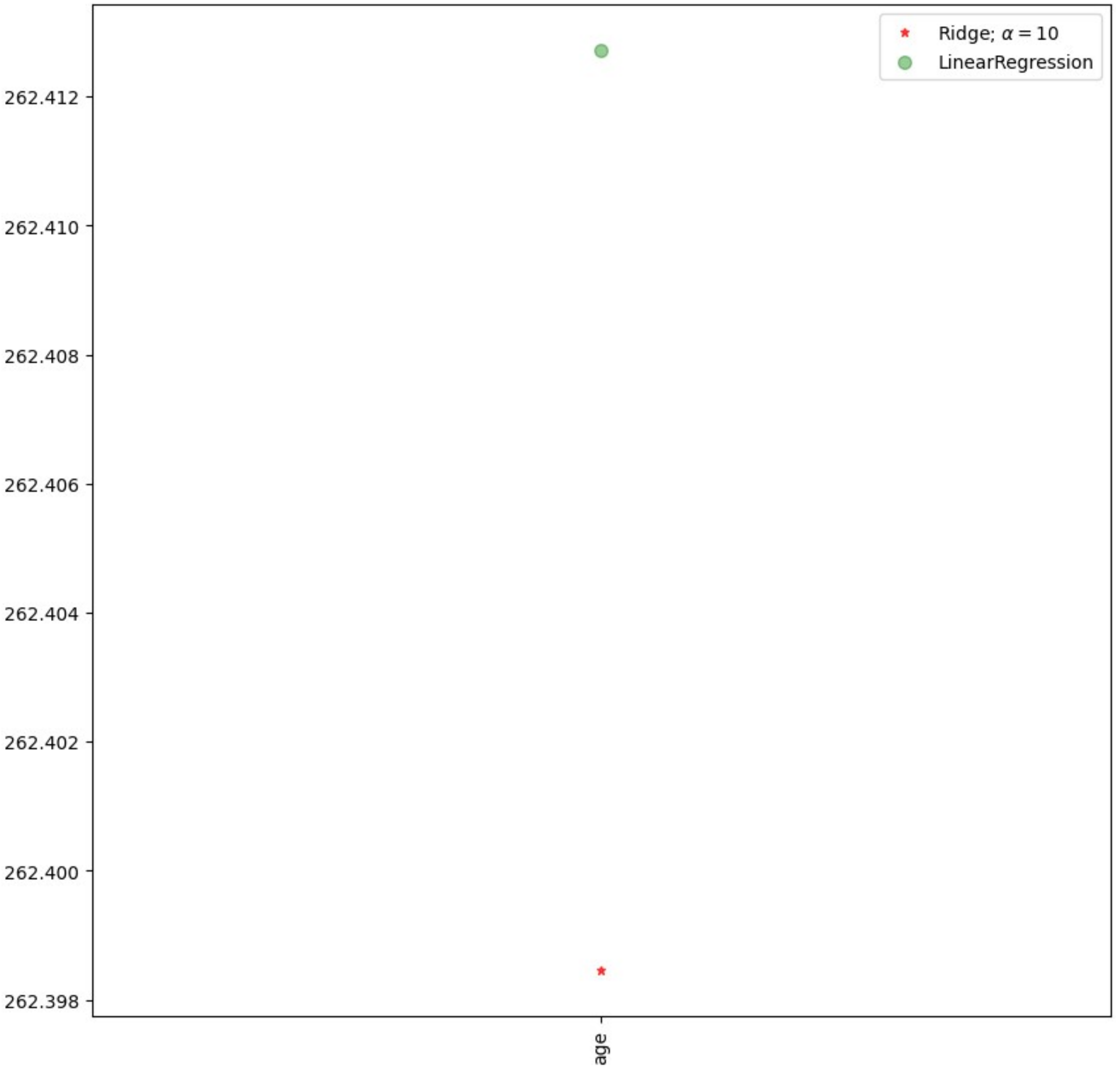
```

Ridge Model :

The train score for ridge model is 0.09109639711159634
The test score for ridge model is 0.08490538609860176
```

In [30]:

```
plt.figure(figsize =(10,10))
plt.plot(features,ridgeReg.coef_,alpha=0.7,linestyle='none',marker='*',mar
plt.plot(features,lr.coef_,alpha=0.4,linestyle='none',marker='o',markersiz
plt.xticks(rotation =90)
plt.legend()
plt.show()
```



Lasso Regression

In [31]:

```
lasso=Lasso(alpha=10)
lasso.fit(x_train,y_train)
train_score_ls =lasso.score(x_train,y_train)
test_score_ls =lasso.score(x_test,y_test)
print("\nRidge Model:\n")
print("The train score for ls model is {}".format(train_score_ls))
print("The test score for ls model is {}".format(test_score_ls))
```

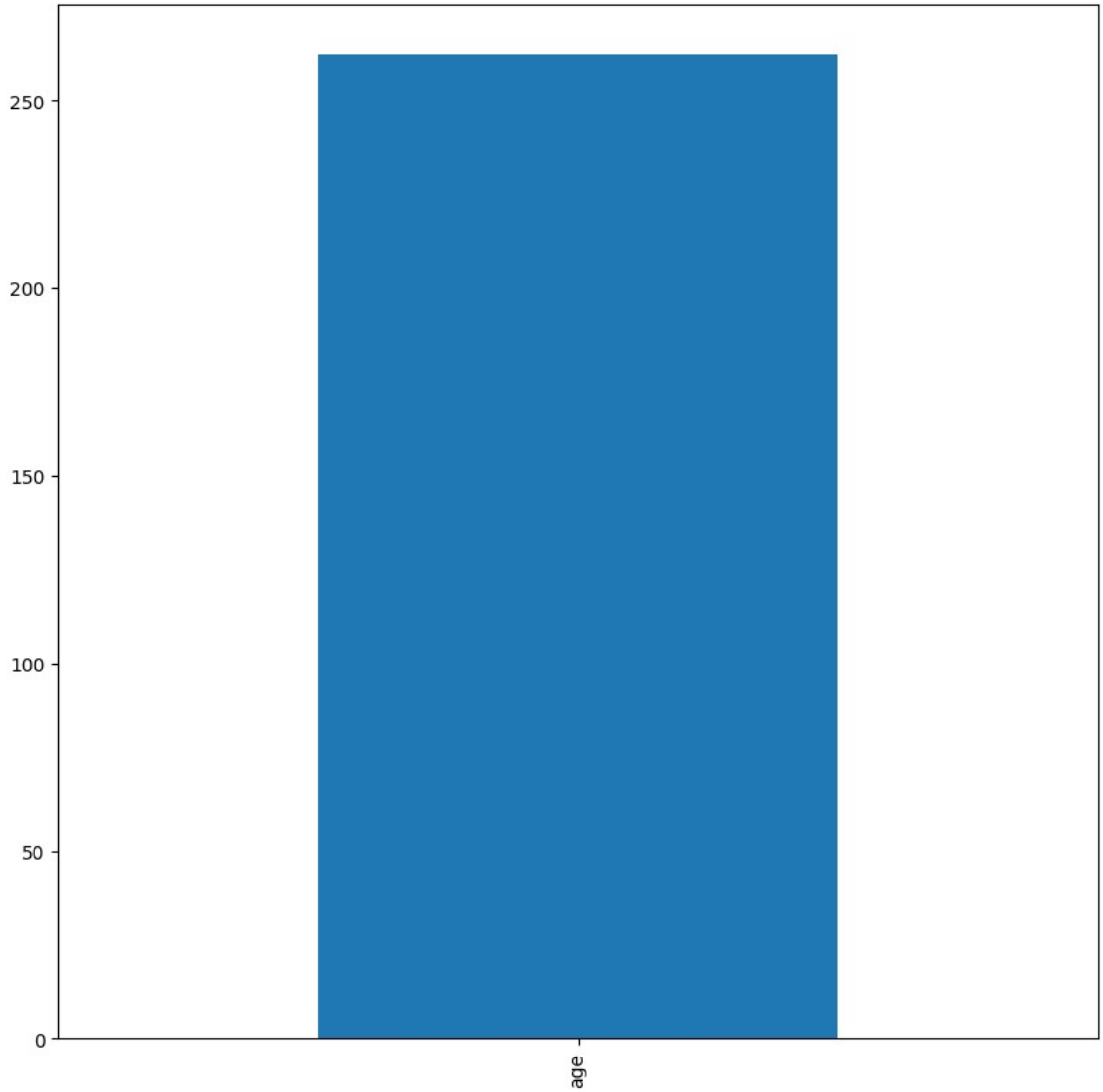
```

Ridge Model:

The train score for ls model is 0.09109639395809055
The test score for ls model is 0.08490704421828055
```

In [32]:

```
plt.figure(figsize=(10,10))
pd.Series(lasso.coef_, features).sort_values(ascending =True).plot(kind =
plt.show()
```



In [33]:

```
from sklearn.linear_model import LassoCV
```

In [34]:

```
#using the Linear CV model
from sklearn.linear_model import RidgeCV
#Lasso Cross validation
ridge_cv = RidgeCV(alphas = [0.0001,0.001,0.01,0.1,1,10]).fit(x_train,y_tr
#score
print(ridge_cv.score(x_train,y_train))
print(ridge_cv.score(x_test,y_test))
```

```
0.09109639711159612
0.08490538609884779
```

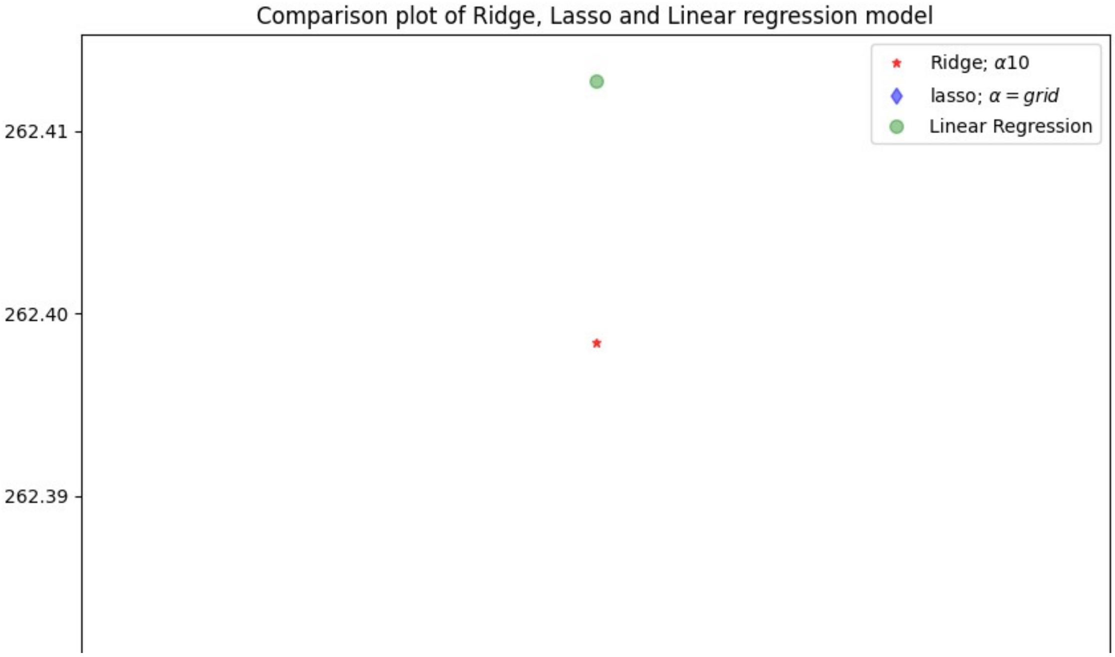
In [47]:

```
#using the linear CV model
from sklearn.linear_model import LassoCV
#Ridge Cross validation
lasso_cv=LassoCV(alphas = [0.0001,0.001,0.01,1,10]).fit(x_train,y_train)
#score
print("The train score for ls model is {}".format(ridge_cv.score(x_train,y_
print("The test score for ls model is {}".format(ridge_cv.score(x_test,y_te
```

```
The train score for ls model is 0.09109639711159612
The test score for ls model is 0.08490538609884779
```

In [48]:

```
plt.figure(figsize = (10, 10))
#add plot for ridge regression
plt.plot(features,ridgeReg.coef_,alpha=0.7,linestyle='none',marker='*',mar
#add plot for lasso regression
plt.plot(lasso_cv.coef_,alpha=0.5,linestyle='none',marker='d',markersize=6
#add plot for linear model
plt.plot(features,lr.coef_,alpha=0.4,linestyle='none',marker='o',markersiz
#rotate axis
plt.xticks(rotation = 90)
plt.legend()
plt.title("Comparison plot of Ridge, Lasso and Linear regression model")
plt.show()
```



Elastic Net Regression

In [49]:

```
from sklearn.linear_model import ElasticNet
el=ElasticNet()
el.fit(x,y)
print(el.coef_)
print(el.intercept_)
```

```
[257.0684655]
3191.532406056678
```

In [50]:

```
y_pred_elastic=el.predict(x_train)
```

In [51]:

```
mean_squared_error=np.mean((y_pred_elastic-y_train)**2)
print("Mean Squared Error on test",mean_squared_error)
```

```
Mean Squared Error on test 135093713.48214507
```

In [52]:

```
el=ElasticNet()
el.fit(x_train,y_train)
print(el.score(x_train,y_train))
```

```
0.09109580670592365
```

Logistic Regression

In [80]:

```
import numpy as np
import pandas as pd
from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import StandardScaler
```

In [81]:

```
df=pd.read_csv(r"C:\Users\chinta pavani\Documents\insurance.csv")
df
```

Out[81]:

	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	yes	southwest	16884.924000
1	18	male	33.770	1	no	southeast	1725.552300
2	28	male	33.000	3	no	southeast	4449.462000
3	33	male	22.705	0	no	northwest	21984.470610
4	32	male	28.880	0	no	northwest	3866.855200
5	31	female	25.740	0	no	southeast	3756.621600
6	46	female	33.440	1	no	southeast	8240.589600
7	37	female	27.740	3	no	northwest	7281.505600
8	37	male	29.830	2	no	northeast	6406.410700
9	60	female	25.840	0	no	northwest	28923.136920
10	25	male	26.220	0	no	northeast	2721.320800

In [82]:

```
df.shape
```

Out[82]:

```
(1338, 7)
```

In [83]:

```
pd.set_option('display.max_rows',10000000000)
pd.set_option('display.max_columns',10000000000)
pd.set_option('display.width',95)
```

In [84]:

```
print('This Dataset has %d rows and %d columns'%(df.shape))
```

```
This Dataset has 1338 rows and 7 columns
```

In [85]:

```
df.head()
```

Out[85]:

	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 [86]:
```
df.describe
```

Out[86]:
```
<bound method NDFrame.describe of       age     sex     bmi  children smo
ker     region      charges
0      19  female  27.900         0    yes  southwest  16884.924000
1      18    male  33.770         1     no  southeast   1725.552300
2      28    male  33.000         3     no  southeast   4449.462000
3      33    male  22.705         0     no  northwest  21984.470610
4      32    male  28.880         0     no  northwest   3866.855200
5      31  female  25.740         0     no  southeast   3756.621600
6      46  female  33.440         1     no  southeast   8240.589600
7      37  female  27.740         3     no  northwest   7281.505600
8      37    male  29.830         2     no  northeast   6406.410700
9      60  female  25.840         0     no  northwest  28923.136920
10     25    male  26.220         0     no  northeast   2721.320800
11     62  female  26.290         0    yes  southeast  27808.725100
12     23    male  34.400         0     no  southwest   1826.843000
13     56  female  39.820         0     no  southeast  11090.717800
14     27    male  42.130         0    yes  southeast  39611.757700
15     19    male  24.600         1     no  southwest   1837.237000
16     52  female  30.780         1     no  northeast  10797.336200
17     23    male  23.845         0     no  northeast   2395.171550
```

In [87]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1338 entries, 0 to 1337
Data columns (total 7 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       1338 non-null   int64  
 1   sex       1338 non-null   object 
 2   bmi       1338 non-null   float64
 3   children  1338 non-null   int64  
 4   smoker    1338 non-null   object 
 5   region    1338 non-null   object 
 6   charges   1338 non-null   float64
dtypes: float64(2), int64(2), object(3)
memory usage: 73.3+ KB
```

In [88]:
```
df.isnull().sum()
```

Out[88]:
```
age         0
sex         0
bmi         0
children    0
smoker      0
region      0
charges     0
dtype: int64
```

In [89]:

```
convert={"smoker":{"yes":1,"no":0}}
df=df.replace(convert)
df
```

Out[89]:

	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	1	southwest	16884.924000
1	18	male	33.770	1	0	southeast	1725.552300
2	28	male	33.000	3	0	southeast	4449.462000
3	33	male	22.705	0	0	northwest	21984.470610
4	32	male	28.880	0	0	northwest	3866.855200
5	31	female	25.740	0	0	southeast	3756.621600
6	46	female	33.440	1	0	southeast	8240.589600
7	37	female	27.740	3	0	northwest	7281.505600
8	37	male	29.830	2	0	northeast	6406.410700
9	60	female	25.840	0	0	northwest	28923.136920
10	25	male	26.220	0	0	northeast	2721.320800

In [90]:

```
convert={"sex":{"female":1,"male":0}}
df=df.replace(convert)
df
```

Out[90]:

	age	sex	bmi	children	smoker	region	charges
0	19	1	27.900	0	1	southwest	16884.924000
1	18	0	33.770	1	0	southeast	1725.552300
2	28	0	33.000	3	0	southeast	4449.462000
3	33	0	22.705	0	0	northwest	21984.470610
4	32	0	28.880	0	0	northwest	3866.855200
5	31	1	25.740	0	0	southeast	3756.621600
6	46	1	33.440	1	0	southeast	8240.589600
7	37	1	27.740	3	0	northwest	7281.505600
8	37	0	29.830	2	0	northeast	6406.410700
9	60	1	25.840	0	0	northwest	28923.136920
10	25	0	26.220	0	0	northeast	2721.320800

In [91]:

```
convert={"region":{"southeast":1,"southwest":2,"northeast":3,"northwest":4
df=df.replace(convert)
df
```

Out[91]:

	age	sex	bmi	children	smoker	region	charges
0	19	1	27.900	0	1	2	16884.924000
1	18	0	33.770	1	0	1	1725.552300
2	28	0	33.000	3	0	1	4449.462000
3	33	0	22.705	0	0	4	21984.470610
4	32	0	28.880	0	0	4	3866.855200
5	31	1	25.740	0	0	1	3756.621600
6	46	1	33.440	1	0	1	8240.589600
7	37	1	27.740	3	0	4	7281.505600
8	37	0	29.830	2	0	3	6406.410700
9	60	1	25.840	0	0	4	28923.136920
10	25	0	26.220	0	0	3	2721.320800

In [92]:

```
features_matrix=df.iloc[:,0:4]
```

In [93]:

```
target_vector=df.iloc[:,-3]
```

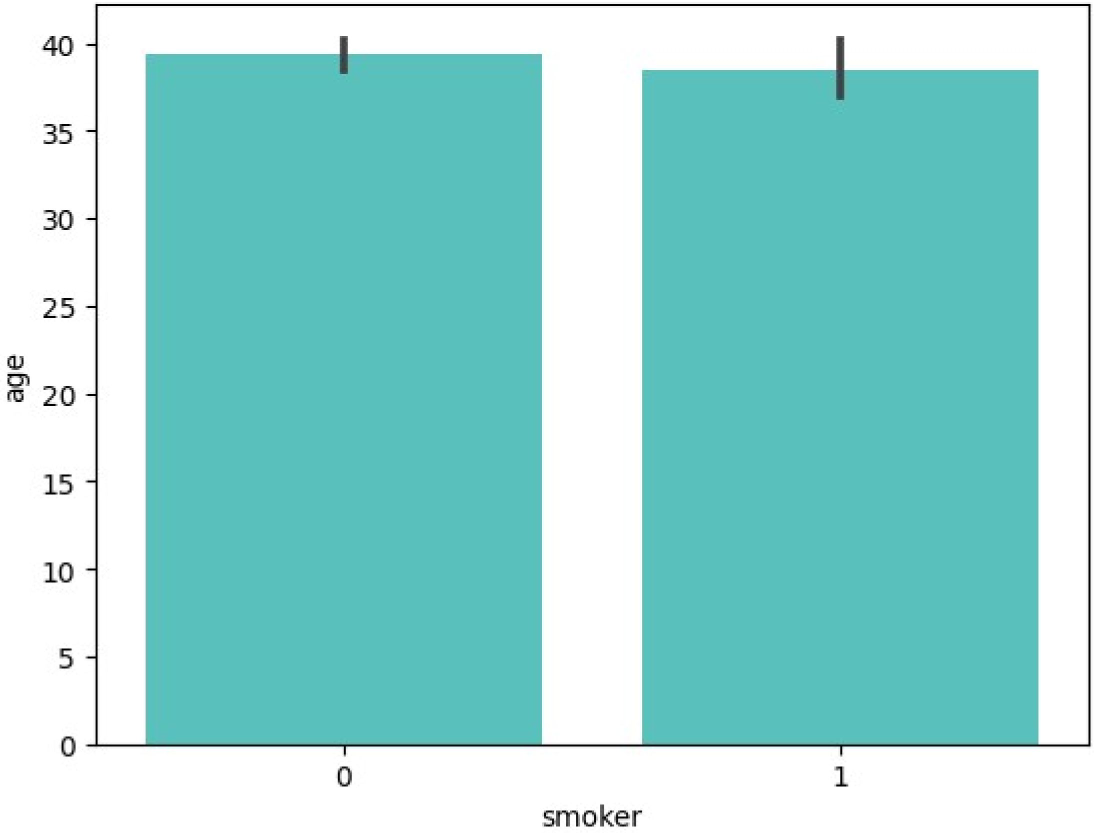
In [94]:

```
print('The Feature Matrix has %d Rows and %d columns(s)'%(features_matrix.
print('The Target Matrix has %d Rows and %d columns(s)'%(np.array(target_v
```

```
The Feature Matrix has 1338 Rows and 4 columns(s)
The Target Matrix has 1338 Rows and 1 columns(s)
```

In [95]:

```
import matplotlib.pyplot as plt
import seaborn as sns
sns.barplot(x='smoker', y='age', data=df, color="mediumturquoise")
plt.show()
```



In [136]:

```
features_matrix_standardized=StandardScaler().fit_transform(features_matri
```

In [137]:

```
algorithm=LogisticRegression(max_iter=10000)
```

In [138]:

```
Logistic_Regression_Model=algorithm.fit(features_matrix_standardized,targe
```

In [139]:

```
observation=[[1,0,0.99539,-0.0588]]
```

In [140]:

```
predictions=Logistic_Regression_Model.predict(observation)
print('The model predicted the observation to belong to class %s'%(predict
```

```
The model predicted the observation to belong to class [0]
```

In [141]:

```
print('The algoritham was trained to predict one of the two classes:%s'%(a
```

```
The algoritham was trained to predict one of the two classes:[0 1]
```

In [142]:

```
print(" " "The Model says the probability of the observation we passed bel
print()
```

```
 The Model says the probability of the observation we passed belonging to
class[0] 0.8057075871331396
```

In [148]:

```
print(" " "The Model says the probability of the observation we passed bel
print()
```

```
 The Model says the probability of the observation we passed belonging to
class['g'] is 0.19429241286686041
```

In [146]:

```
x=np.array(df['age']).reshape(-1,1)
y=np.array(df['smoker']).reshape(-1,1)
```

In [102]:

```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.05)
lo=LogisticRegression()
lo.fit(x_train,y_train)
print(lo.score(x_test,y_test))
```

```
0.7910447761194029

C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-p
ackages\sklearn\utils\validation.py:1143: DataConversionWarning: A column
-vector y was passed when a 1d array was expected. Please change the shap
e of y to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
```

Decision Tree

In [103]:

```
import numpy as np
import pandas as pd
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
```

In [104]:

```
df=pd.read_csv(r"C:\Users\chinta pavani\Documents\insurance.csv")
df
```

Out[104]:

	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	yes	southwest	16884.924000
1	18	male	33.770	1	no	southeast	1725.552300
2	28	male	33.000	3	no	southeast	4449.462000
3	33	male	22.705	0	no	northwest	21984.470610
4	32	male	28.880	0	no	northwest	3866.855200
5	31	female	25.740	0	no	southeast	3756.621600
6	46	female	33.440	1	no	southeast	8240.589600
7	37	female	27.740	3	no	northwest	7281.505600
8	37	male	29.830	2	no	northeast	6406.410700
9	60	female	25.840	0	no	northwest	28923.136920
10	25	male	26.220	0	no	northeast	2721.320800

In [105]:

```
df.shape
```

Out[105]:

```
(1338, 7)
```

In [106]:

```
df.isnull().any()
```

Out[106]:

```
age         False
sex         False
bmi         False
children    False
smoker      False
region      False
charges     False
dtype: bool
```

In [107]:

```
df['region'].value_counts()
```

Out[107]:

```
region
southeast    364
southwest    325
northwest    325
northeast    324
Name: count, dtype: int64
```

In [108]:

```
convert={"sex":{"female":1,"male":0}}
df=df.replace(convert)
df
```

Out[108]:

	age	sex	bmi	children	smoker	region	charges
0	19	1	27.900	0	yes	southwest	16884.924000
1	18	0	33.770	1	no	southeast	1725.552300
2	28	0	33.000	3	no	southeast	4449.462000
3	33	0	22.705	0	no	northwest	21984.470610
4	32	0	28.880	0	no	northwest	3866.855200
5	31	1	25.740	0	no	southeast	3756.621600
6	46	1	33.440	1	no	southeast	8240.589600
7	37	1	27.740	3	no	northwest	7281.505600
8	37	0	29.830	2	no	northeast	6406.410700
9	60	1	25.840	0	no	northwest	28923.136920
10	25	0	26.220	0	no	northeast	2721.320800

In [109]:

```
convert={"smoker":{"yes":1,"no":0}}
df=df.replace(convert)
df
```

Out[109]:

	age	sex	bmi	children	smoker	region	charges
0	19	1	27.900	0	1	southwest	16884.924000
1	18	0	33.770	1	0	southeast	1725.552300
2	28	0	33.000	3	0	southeast	4449.462000
3	33	0	22.705	0	0	northwest	21984.470610
4	32	0	28.880	0	0	northwest	3866.855200
5	31	1	25.740	0	0	southeast	3756.621600
6	46	1	33.440	1	0	southeast	8240.589600
7	37	1	27.740	3	0	northwest	7281.505600
8	37	0	29.830	2	0	northeast	6406.410700
9	60	1	25.840	0	0	northwest	28923.136920
10	25	0	26.220	0	0	northeast	2721.320800

In [110]:

```
x=["bmi","children"]
y=["Yes","No"]
all_inputs=df[x]
all_classes=df["sex"]
```

In [111]:

```
(x_train,x_test,y_train,y_test)=train_test_split(all_inputs,all_classes,te
```

In [112]:
```
clf=DecisionTreeClassifier(random_state=0)
```

In [113]:
```
clf.fit(x_train,y_train)
```

Out[113]:
```
▾         DecisionTreeClassifier

DecisionTreeClassifier(random_state=0)
```

In [114]:
```
DecisionTreeClassifier(random_state=0)
score=clf.score(x_test,y_test)
print(score)
```

```
0.4878048780487805
```

Random Forest

In [115]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt ,seaborn as sns
```

In [116]:
```
df=pd.read_csv(r"C:\Users\chinta pavani\Documents\insurance.csv")
df
```

Out[116]:

	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	yes	southwest	16884.924000
1	18	male	33.770	1	no	southeast	1725.552300
2	28	male	33.000	3	no	southeast	4449.462000
3	33	male	22.705	0	no	northwest	21984.470610
4	32	male	28.880	0	no	northwest	3866.855200
5	31	female	25.740	0	no	southeast	3756.621600
6	46	female	33.440	1	no	southeast	8240.589600
7	37	female	27.740	3	no	northwest	7281.505600
8	37	male	29.830	2	no	northeast	6406.410700
9	60	female	25.840	0	no	northwest	28923.136920
10	25	male	26.220	0	no	northeast	2721.320800

In [117]:
```
df.shape
```

Out[117]:
```
(1338, 7)
```

In [118]:

```
df['region'].value_counts()
```

Out[118]:

```
region
southeast    364
southwest    325
northwest    325
northeast    324
Name: count, dtype: int64
```

In [119]:

```
df['bmi'].value_counts()
```

Out[119]:

```
bmi
32.300    13
28.310     9
30.495     8
30.875     8
31.350     8
30.800     8
34.100     8
28.880     8
33.330     7
35.200     7
25.800     7
32.775     7
27.645     7
32.110     7
38.060     7
25.460     7
30.590     7
27.360     7
```

In [121]:

```
m={"sex":{"female":1,"male":0}}
df=df.replace(m)
print(df)
```

```
      age  sex     bmi  children smoker     region       charges
0      19    1  27.900         0    yes  southwest  16884.924000
1      18    0  33.770         1     no  southeast   1725.552300
2      28    0  33.000         3     no  southeast   4449.462000
3      33    0  22.705         0     no  northwest  21984.470610
4      32    0  28.880         0     no  northwest   3866.855200
5      31    1  25.740         0     no  southeast   3756.621600
6      46    1  33.440         1     no  southeast   8240.589600
7      37    1  27.740         3     no  northwest   7281.505600
8      37    0  29.830         2     no  northeast   6406.410700
9      60    1  25.840         0     no  northwest  28923.136920
10     25    0  26.220         0     no  northeast   2721.320800
11     62    1  26.290         0    yes  southeast  27808.725100
12     23    0  34.400         0     no  southwest   1826.843000
13     56    1  39.820         0     no  southeast  11090.717800
14     27    0  42.130         0    yes  southeast  39611.757700
15     19    0  24.600         1     no  southwest   1837.237000
16     52    1  30.780         1     no  northeast  10797.336200
17     23    0  23.845         0     no  northeast   2395.171550
```

In [122]:

```
n={"smoker":{"yes":1,"no":0}}
df=df.replace(n)
print(df)
```

```
      age  sex     bmi  children  smoker     region      charges
0      19    1  27.900         0       1  southwest  16884.924000
1      18    0  33.770         1       0  southeast   1725.552300
2      28    0  33.000         3       0  southeast   4449.462000
3      33    0  22.705         0       0  northwest  21984.470610
4      32    0  28.880         0       0  northwest   3866.855200
5      31    1  25.740         0       0  southeast   3756.621600
6      46    1  33.440         1       0  southeast   8240.589600
7      37    1  27.740         3       0  northwest   7281.505600
8      37    0  29.830         2       0  northeast   6406.410700
9      60    1  25.840         0       0  northwest  28923.136920
10     25    0  26.220         0       0  northeast   2721.320800
11     62    1  26.290         0       1  southeast  27808.725100
12     23    0  34.400         0       0  southwest   1826.843000
13     56    1  39.820         0       0  southeast  11090.717800
14     27    0  42.130         0       1  southeast  39611.757700
15     19    0  24.600         1       0  southwest   1837.237000
16     52    1  30.780         1       0  northeast  10797.336200
17     23    0  23.845         0       0  northeast   2395.171550
18     56    0  40.300         0       0  southwest  10602.385000
```

In [123]:

```
from sklearn.ensemble import RandomForestClassifier
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
```

Out[123]:

```
▾ RandomForestClassifier

RandomForestClassifier()
```

In [124]:

```
rf=RandomForestClassifier()
params={'max_depth':[2,3,5,20],
'min_samples_leaf':[5,10,20,50,100,200],
'n_estimators':[10,25,30,50,100,200]}
```

In [126]:

```
from sklearn.model_selection import GridSearchCV
grid_search=GridSearchCV(estimator=rf,param_grid=params,cv=2,scoring="accu
grid_search.fit(x_train,y_train)
```

Out[126]:

```
▸             GridSearchCV
▸ estimator: RandomForestClassifier
      ▸ RandomForestClassifier
```

In [127]:

```
grid_search.best_score_
```

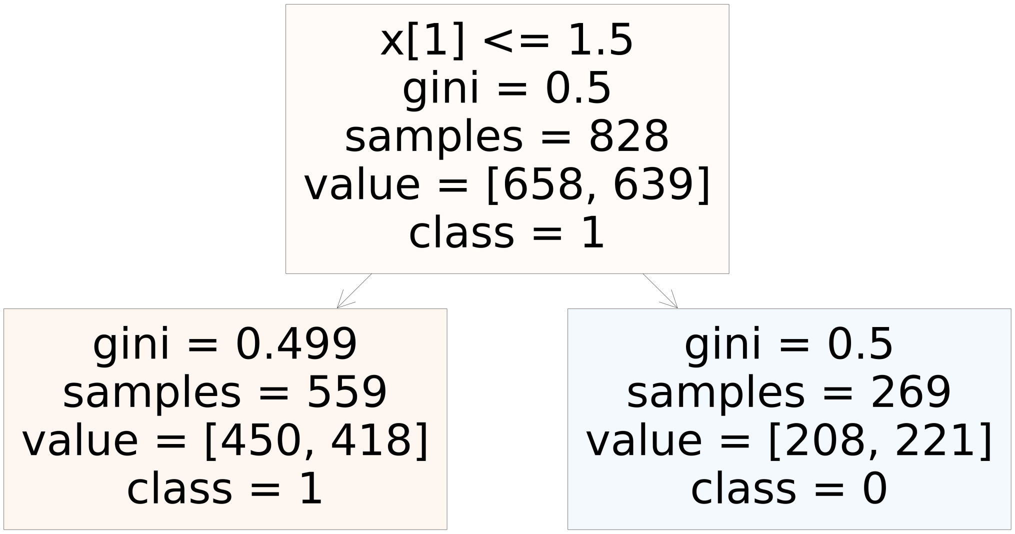
Out[127]:

```
0.5304492666780802
```

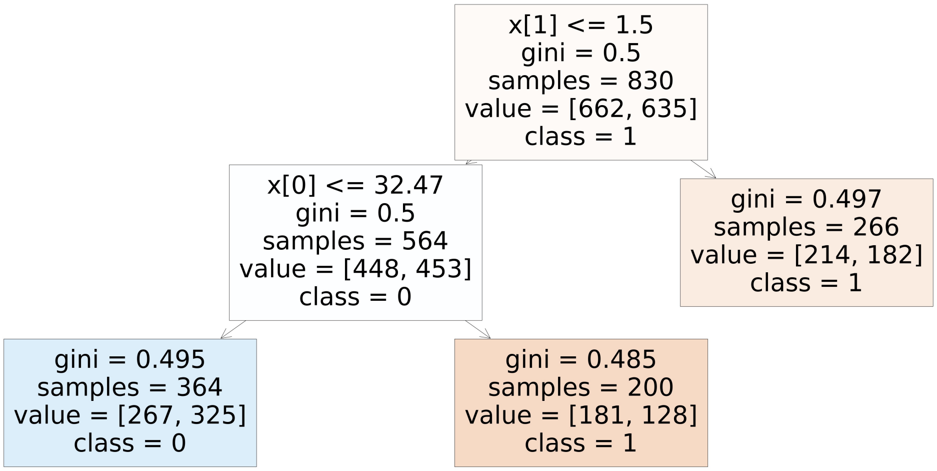
In [128]:
```
rf_best=grid_search.best_estimator_
print(rf_best)
```

```
RandomForestClassifier(max_depth=3, min_samples_leaf=200, n_estimators=1
0)
```

In [129]:
```
from sklearn.tree import plot_tree
plt.figure(figsize=(80,40))
plot_tree(rf_best.estimators_[4],class_names=['1','0'],filled=True);
```



In [131]:
```
from sklearn.tree import plot_tree
plt.figure(figsize=(70,30))
plot_tree(rf_best.estimators_[6],class_names=["1","0"],filled=True);
```



In [132]:
```
rf_best.feature_importances_
```

Out[132]:
```
array([0.53541719, 0.46458281])
```

In [133]:
```
rf=RandomForestClassifier(random_state=0)
```

```
In [134]:  rf.fit(x_train,y_train)

Out[134]:  ▾          RandomForestClassifier
           RandomForestClassifier(random_state=0)
```

```
In [135]:  score=rf.score(x_test,y_test)
           print(score)

           0.4878048780487805
```

```
In [ ]:
```