1)DATA COLLECTION

In [3]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn import preprocessing,svm
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
```

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

Out[4]:

	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

Data Cleaning and Preprocessing

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

Out[5]:

	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 [6]:
```
df.tail()
```

Out[6]:

	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 [7]:
```
df.shape
```

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

In [8]:
```
df.describe
```

Out[8]:
```
<bound method NDFrame.describe of       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 x 7 columns]>
```

In [9]:
```
df.info
```

Out[9]:
```
<bound method DataFrame.info of       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 x 7 columns]>
```

In [10]:
```
df.isnull().any()
```

Out[10]:
```
age         False
sex         False
bmi         False
children    False
smoker      False
region      False
charges     False
dtype: bool
```

In [11]:
```
df.isna().sum()
```

Out[11]:
```
age         0
sex         0
bmi         0
children    0
smoker      0
region      0
charges     0
dtype: int64
```

In [12]:
```
df['region'].value_counts()
```

Out[12]:
```
region
southeast    364
southwest    325
northwest    325
northeast    324
Name: count, dtype: int64
```

In [13]:
```
convert={"sex":{"female":1,"male":0}}
df=df.replace(convert)
df
```

Out[13]:

	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 [14]:
```
convert={"smoker":{"yes":1,"no":0}}
df=df.replace(convert)
df
```

Out[14]:

	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 [15]:
```
convert={"region":{"southwest":1,"southeast":2,"northwest":3,"northeast":4}}
df=df.replace(convert)
df
```

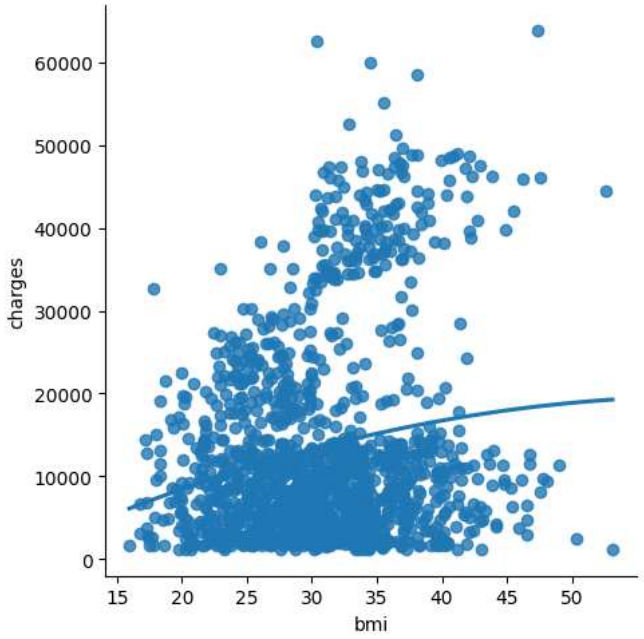
Out[15]:

	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 [16]:
```
sns.lmplot(x='bmi',y='charges',order=2,data=df,ci=None)
plt.show()
```

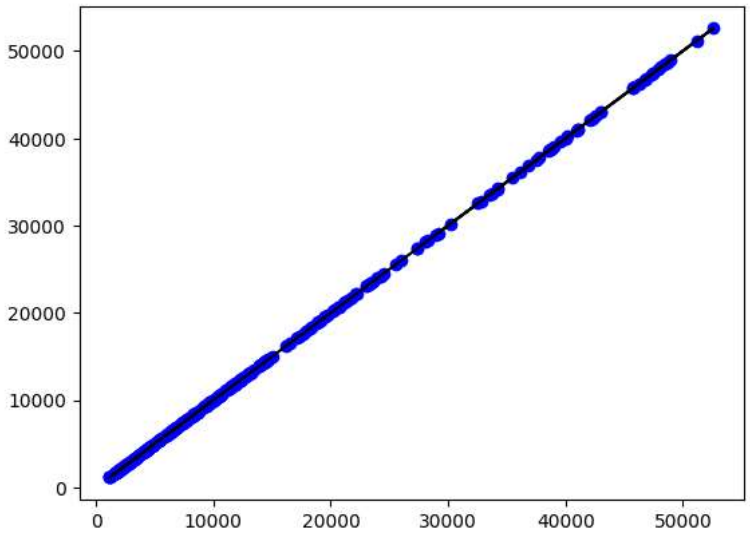


In [17]:
```
x=np.array(df['bmi']).reshape(-1,1)
y=x=np.array(df['charges']).reshape(-1,1)
```

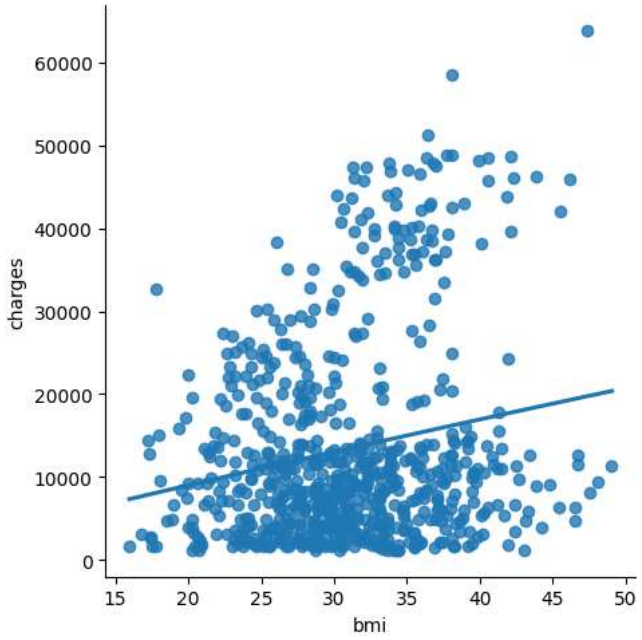
In [18]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.25,random_state=0)
lr=LinearRegression()
lr.fit(x_train,y_train)
print(lr.score(x_test,y_test))
```

```
1.0
```

In [19]:
```
y_pred=lr.predict(x_test)
plt.scatter(x_test,y_test,color='b')
plt.plot(x_test,y_pred,color='k')
plt.show()
```



In [20]:
```
df700=df[:][:700]
sns.lmplot(x='bmi',y='charges',order=2,ci=None,data=df700)
plt.show()
```



In [21]:
```
df700.fillna(method='ffill',inplace=True)
```

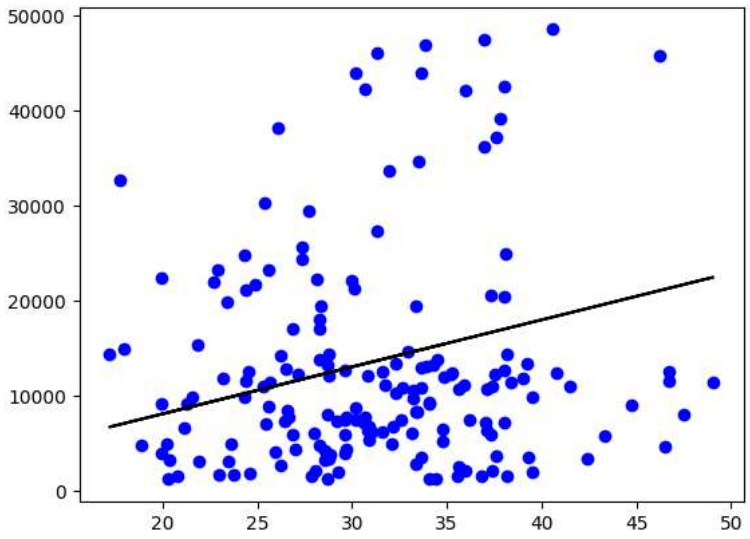
In [22]:
```
x=np.array(df700["bmi"]).reshape(-1,1)
y=np.array(df700['charges']).reshape(-1,1)
```

In [23]:
```
df700.dropna(inplace=True)
```

In [24]:
```
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))
```

```
-0.03194738470035441
```

In [25]:
```
y_pred=lr.predict(x_test)
plt.scatter(x_test,y_test,color='b')
plt.plot(x_test,y_pred,color='k')
plt.show()
```



In [26]:
```
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score
```

In [27]:
```
lr=LinearRegression()
lr.fit(x_train,y_train)
y_pred=lr.predict(x_test)
r2=r2_score(y_test,y_pred)
print(r2)
```

```
-0.03194738470035441
```

In [28]:
```
from sklearn.linear_model import Lasso,Ridge
from sklearn.preprocessing import StandardScaler
```

In [29]:
```
plt.figure(figsize=(10,10))
sns.heatmap(df700.corr(),annot=True)
plt.show()
```

In [30]:
```
features=df.columns[0:1]
target=df.columns[-1]
```

In [31]:
```
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,random_state=1)
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 [32]:
```
lr = LinearRegression()
#Fit model
lr.fit(x_train, y_train)
#predict
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 0.0910963973805714
The test score for lr model is 0.08490473916580776
```

In [33]:
```
ridgeReg = Ridge(alpha=10)
ridgeReg.fit(x_train,y_train)
#train and test scorefor 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))
```

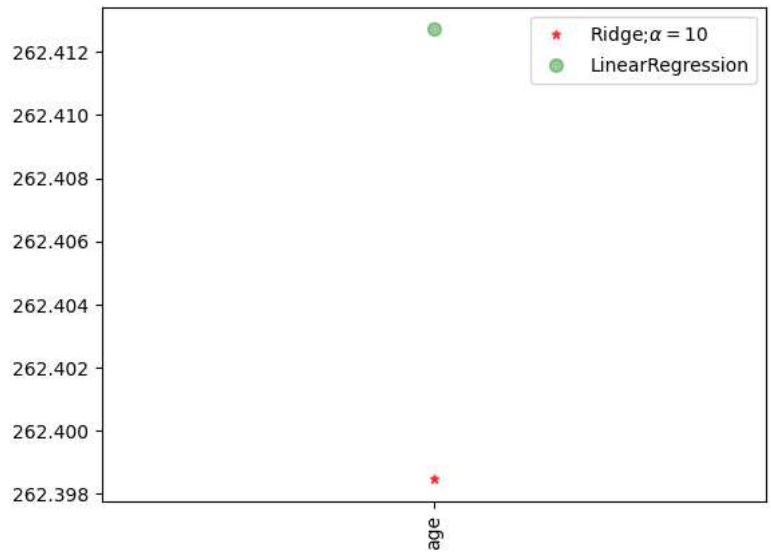
```
Ridge Model:

The train score for ridge model is 0.09109639711159634
The test score for ridge model is 0.08490538609860199
```

In [34]:
```
plt.figure(figsize=(10,10))
```

Out[34]:
```
<Figure size 1000x1000 with 0 Axes>
```

```
<Figure size 1000x1000 with 0 Axes>
```

In [35]:
```
plt.plot(features,ridgeReg.coef_,alpha=0.7,linestyle='none',marker="*",markersize=5,color='red',label=r'Ridge;$\alpha=10$',zorder
plt.plot(features,lr.coef_,alpha=0.4,linestyle='none',marker="o",markersize=7,color='green',label='LinearRegression')
plt.xticks(rotation=90)
plt.legend()
plt.show()
```



Lasso Regression

In [36]:
```
lasso= Lasso(alpha=10)
lasso.fit(x_train,y_train)
#train and test scorefor ridge regression
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 lasso model is {}".format(train_score_ls))
print("The test score for lasso model is {}".format(test_score_ls))
```

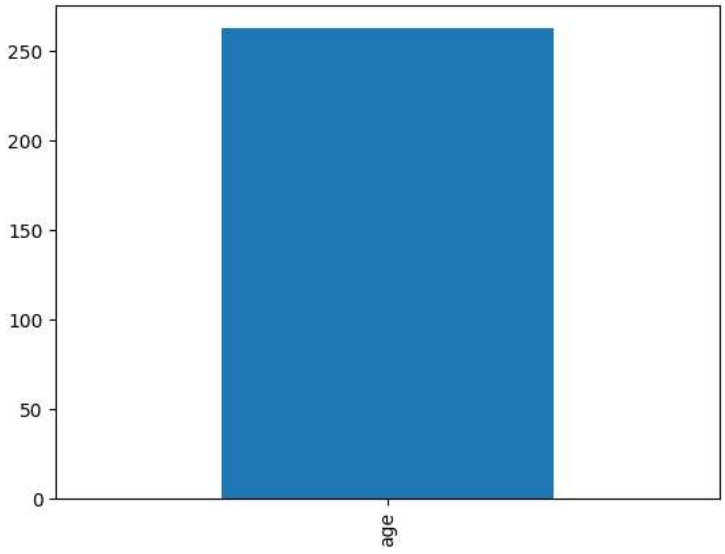
```
Ridge Model:

The train score for lasso model is 0.09109639395809044
The test score for lasso model is 0.08490704421828055
```

In [37]:
```
plt.figure(figsize=(10,10))
```

Out[37]:
```
<Figure size 1000x1000 with 0 Axes>
```

```
<Figure size 1000x1000 with 0 Axes>
```

In [38]:
```
pd.Series(lasso.coef_, features).sort_values(ascending = True).plot(kind = "bar")
plt.show()
```



In [39]:
```
from sklearn.linear_model import LassoCV
```

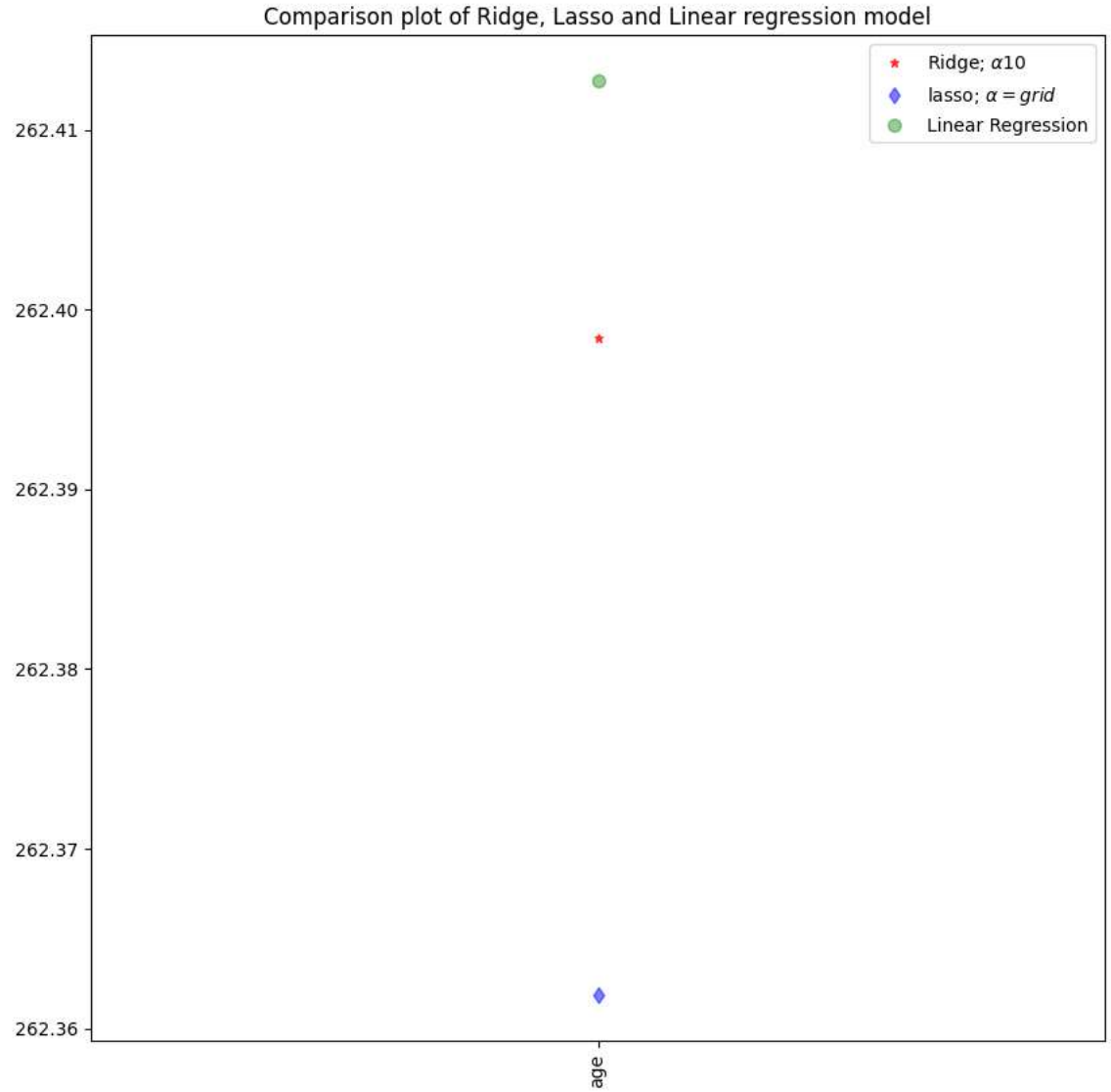
In [40]:
```
#using the linear cv model
from sklearn.linear_model import RidgeCV
#cross validation
ridge_cv=RidgeCV(alphas =[0.0001,0.001,0.01,0.1,1,10]).fit(x_train,y_train)
#score
print(ridge_cv.score(x_train,y_train))
print(ridge_cv.score(x_test,y_test))
```

```
0.09109639711159612
0.08490538609885023
```

In [41]:
```
#using the linear cv model
from sklearn.linear_model import LassoCV
#cross validation
lasso_cv=LassoCV(alphas =[0.0001,0.001,0.01,0.1,1,10]).fit(x_train,y_train)
#score
print(lasso_cv.score(x_train,y_train))
print(lasso_cv.score(x_test,y_test))
```

```
0.09109639395809044
0.08490704421828055
```

In [42]:
```
plt.figure(figsize = (10, 10))
#add plot for ridge regression
plt.plot(features,ridgeReg.coef_,alpha=0.7,linestyle='none',marker='*',markersize=5,color='red',label=r'Ridge; $\alpha10$',zorder
#add plot for lasso regression
plt.plot(lasso_cv.coef_,alpha=0.5,linestyle='none',marker='d',markersize=6,color='blue',label=r'lasso; $\alpha = grid$')
#add plot for linear model
plt.plot(features,lr.coef_,alpha=0.4,linestyle='none',marker='o',markersize=7,color='green',label='Linear Regression')
#rotate axis
plt.xticks(rotation = 90)
plt.legend()
plt.title("Comparison plot of Ridge, Lasso and Linear regression model")
plt.show()
```



In [43]:
```
from sklearn.linear_model import ElasticNet
```

In [44]:
```
el=ElasticNet()
el.fit(x_train,y_train)
print(el.coef_)
print(el.intercept_)
```

```
[261.74450967]
3115.0831774262424
```

In [45]:
```
y_pred_elastic=el.predict(x_train)
```

In [46]:
```
mean_squared_error=np.mean((y_pred_elastic-y_train)**2)
print(mean_squared_error)
```

```
135077142.70714515
```

In [47]:
```
el=ElasticNet()
el.fit(x_train,y_train)
print(el.score(x_train,y_train))
```

```
0.09109580670592365
```

Logistic Regression

In [48]:
```
import numpy as np
import pandas as pd
from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import StandardScaler
```

In [49]:
```
df=pd.read_csv(r"C:\Users\manasa\Downloads\insurance.csv")
df
```

Out[49]:

	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

In [50]:
```
df.shape
```

Out[50]:
```
(1338, 7)
```

In [51]:
```
pd.set_option('display.max_rows',10000000000)
pd.set_option('display.max_columns',10000000000)
pd.set_option('display.width',95)
```

In [52]:
```
print('This Dataset has %d rows and %d columns'%(df.shape))
```

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

In [53]:
```
df.head()
```

Out[53]:

	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 [54]:
```
df.describe
```

```
187    30  female  30.900         3     no  southwest   5325.651000
188    41  female  32.200         1     no  southwest   6775.961000
189    29  female  32.110         2     no  northwest   4922.915900
190    61    male  31.570         0     no  southeast  12557.605300
191    36  female  26.200         0     no  southwest   4883.866000
192    25    male  25.740         0     no  southeast   2137.653600
193    56  female  26.600         1     no  northwest  12044.342000
194    18    male  34.430         0     no  southeast   1137.469700
195    19    male  30.590         0     no  northwest   1639.563100
196    39  female  32.800         0     no  southwest   5649.715000
197    45  female  28.600         2     no  southeast   8516.829000
198    51  female  18.050         0     no  northwest   9644.252500
199    64  female  39.330         0     no  northeast  14901.516700
200    19  female  32.110         0     no  northwest   2130.675900
201    48  female  32.230         1     no  southeast   8871.151700
202    60  female  24.035         0     no  northwest  13012.208650
203    27  female  36.080         0    yes  southeast  37133.898200
204    46    male  22.300         0     no  southwest   7147.105000
205    28  female  28.880         1     no  northeast   4337.735200
206    59    male  26.400         0     no  southeast  11743.299000
```

In [55]:
```
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 [56]:
```
df.isnull().sum()
```

Out[56]:
```
age         0
sex         0
bmi         0
children    0
smoker      0
region      0
charges     0
dtype: int64
```

In [57]:
```
convert={"smoker":{"yes":1,"no":0}}
df=df.replace(convert)
df
```

33	63	male	28.310	0	0	northwest	13770.097900
34	28	male	36.400	1	1	southwest	51194.559140
35	19	male	20.425	0	0	northwest	1625.433750
36	62	female	32.965	3	0	northwest	15612.193350
37	26	male	20.800	0	0	southwest	2302.300000
38	35	male	36.670	1	1	northeast	39774.276300
39	60	male	39.900	0	1	southwest	48173.361000
40	24	female	26.600	0	0	northeast	3046.062000
41	31	female	36.630	2	0	southeast	4949.758700
42	41	male	21.780	1	0	southeast	6272.477200
43	37	female	30.800	2	0	southeast	6313.759000
44	38	male	37.050	1	0	northeast	6079.671500
45	55	male	37.300	0	0	southwest	20630.283510

In [58]:
```
convert={"sex":{"female":1,"male":0}}
df=df.replace(convert)
df
```

41	31	1	36.630	2	0	southeast	4949.758700
42	41	0	21.780	1	0	southeast	6272.477200
43	37	1	30.800	2	0	southeast	6313.759000
44	38	0	37.050	1	0	northeast	6079.671500
45	55	0	37.300	0	0	southwest	20630.283510
46	18	1	38.665	2	0	northeast	3393.356350
47	28	1	34.770	0	0	northwest	3556.922300
48	60	1	24.530	0	0	southeast	12629.896700
49	36	0	35.200	1	1	southeast	38709.176000
50	18	1	35.625	0	0	northeast	2211.130750
51	21	1	33.630	2	0	northwest	3579.828700
52	48	0	28.000	1	1	southwest	23568.272000
53	36	0	34.430	0	1	southeast	37742.575700

In [59]:
```
convert={"region":{"southeast":1,"southwest":2,"northeast":3,"northwest":4}}
df=df.replace(convert)
df
```

Out[59]:

	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 [60]:
```
features_matrix=df.iloc[:,0:4]
```

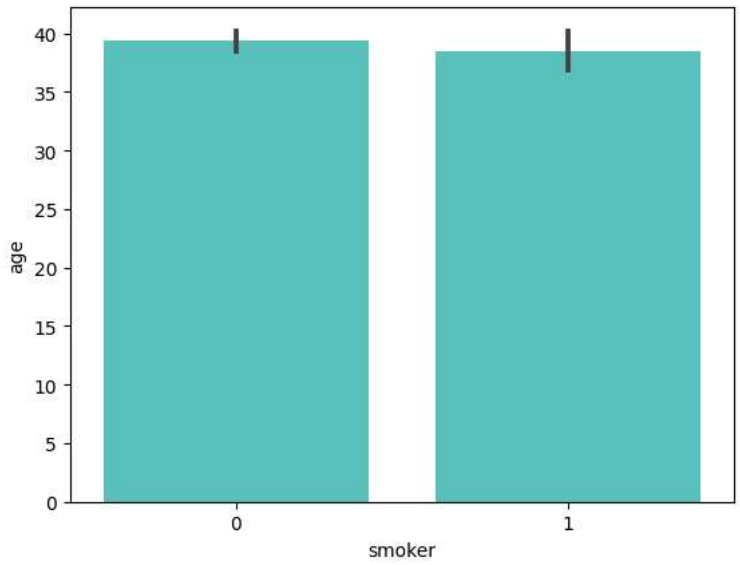
In [61]:
```
target_vector=df.iloc[:,-3]
```

In [95]:
```
print('The Feature Matrix has %d Rows and %d columns(s)'%(features_matrix.shape))
print('The Target Matrix has %d Rows and %d columns(s)'%(np.array(target_vector).reshape(-1,1).shape))
```

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

In [99]:
```
import matplotlib.pyplot as plt
import seaborn as sns
```

In [101]:
```
sns.barplot(x='smoker', y='age', data=df, color="mediumturquoise")
plt.show()
```



In [102]:
```
features_matrix_standardized=StandardScaler().fit_transform(features_matrix)
```

In [103]:
```
algorithm=LogisticRegression(max_iter=10000)
```

In [105]:
```
Logistic_Regression_Model=algorithm.fit(features_matrix_standardized,target_vector)
```

In [106]:
```
observation=[[1,0,0.99539,-0.0588]]
```

In [108]:
```
predictions=Logistic_Regression_Model.predict(observation)
print('The model predicted the observation to belong to class %s'%(predictions))
```

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

In [110]:
```
print('The algoritham was trained to predict one of the two classes:%s'%(algorithm.classes_))
```

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

In [114]:
```
print(" " "The Model says the probability of the observation we passed belonging to class[0] %s" " "%(algorithm.predict_proba(obs
```

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

In [120]:
```
print(" " "The Model says the probability of the observation we passed belonging to class['g'] is %s" " "%(algorithm.predict_prob
print()
```

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

In [121]:
```
x=np.array(df['age']).reshape(-1,1)
y=np.array(df['smoker']).reshape(-1,1)
```

In [124]:
```
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))
```

```
0.8208955223880597

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

Decision Tree

In [63]:
```
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 [64]:
```
df=pd.read_csv(r"C:\Users\manasa\Downloads\insurance.csv")
df
```

33	63	male	28.310	0	no	northwest	13770.097900
34	28	male	36.400	1	yes	southwest	51194.559140
35	19	male	20.425	0	no	northwest	1625.433750
36	62	female	32.965	3	no	northwest	15612.193350
37	26	male	20.800	0	no	southwest	2302.300000
38	35	male	36.670	1	yes	northeast	39774.276300
39	60	male	39.900	0	yes	southwest	48173.361000
40	24	female	26.600	0	no	northeast	3046.062000
41	31	female	36.630	2	no	southeast	4949.758700
42	41	male	21.780	1	no	southeast	6272.477200
43	37	female	30.800	2	no	southeast	6313.759000
44	38	male	37.050	1	no	northeast	6079.671500
45	55	male	37.300	0	no	southwest	20630.283510

In [65]:
```
df.shape
```

Out[65]:
```
(1338, 7)
```

In [66]:
```
df.isnull().any()
```

Out[66]:
```
age         False
sex         False
bmi         False
children    False
smoker      False
region      False
charges     False
dtype: bool
```

In [67]:
```
df['region'].value_counts()
```

Out[67]:
```
region
southeast    364
southwest    325
northwest    325
northeast    324
Name: count, dtype: int64
```

In [68]:
```
convert={"sex":{"female":1,"male":0}}
df=df.replace(convert)
df
```

91	53	1	24.795	1	no	northwest	10942.132050
92	59	0	29.830	3	yes	northeast	30184.936700
93	35	0	34.770	2	no	northwest	5729.005300
94	64	1	31.300	2	yes	southwest	47291.055000
95	28	1	37.620	1	no	southeast	3766.883800
96	54	1	30.800	3	no	southwest	12105.320000
97	55	0	38.280	0	no	southeast	10226.284200
98	56	0	19.950	0	yes	northeast	22412.648500
99	38	0	19.300	0	yes	southwest	15820.699000
100	41	1	31.600	0	no	southwest	6186.127000
101	30	0	25.460	0	no	northeast	3645.089400
102	18	1	30.115	0	no	northeast	21344.846700
103	61	1	29.920	3	yes	southeast	30942.191800

In [69]:
```
convert={"smoker":{"yes":1,"no":0}}
df=df.replace(convert)
df
```

21	30	1	32.400	1	0	southwest	4149.736000
22	18	0	34.100	0	0	southeast	1137.011000
23	34	1	31.920	1	1	northeast	37701.876800
24	37	0	28.025	2	0	northwest	6203.901750
25	59	1	27.720	3	0	southeast	14001.133800
26	63	1	23.085	0	0	northeast	14451.835150
27	55	1	32.775	2	0	northwest	12268.632250
28	23	0	17.385	1	0	northwest	2775.192150
29	31	0	36.300	2	1	southwest	38711.000000
30	22	0	35.600	0	1	southwest	35585.576000
31	18	1	26.315	0	0	northeast	2198.189850
32	19	1	28.600	5	0	southwest	4687.797000
33	63	0	28.310	0	0	northwest	13770.097900

In [70]:
```
x=["bmi","children"]
y=["Yes","No"]
all_inputs=df[x]
all_classes=df["sex"]
```

In [71]:
```
(x_train,x_test,y_train,y_test)=train_test_split(all_inputs,all_classes,test_size=0.25)
```

In [72]:
```
clf=DecisionTreeClassifier(random_state=0)
```

In [73]:
```
clf.fit(x_train,y_train)
```

Out[73]:
```
DecisionTreeClassifier
DecisionTreeClassifier(random_state=0)
```

In [74]:
```
DecisionTreeClassifier(random_state=0)
score=clf.score(x_test,y_test)
print(score)
```

```
0.45671641791044776
```

Random Forest

In [75]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt ,seaborn as sns
```

In [76]:
```
df=pd.read_csv(r"C:\Users\manasa\Downloads\insurance.csv")
df
```

45	55	male	37.300	0	no	southwest	20630.283510
46	18	female	38.665	2	no	northeast	3393.356350
47	28	female	34.770	0	no	northwest	3556.922300
48	60	female	24.530	0	no	southeast	12629.896700
49	36	male	35.200	1	yes	southeast	38709.176000
50	18	female	35.625	0	no	northeast	2211.130750
51	21	female	33.630	2	no	northwest	3579.828700
52	48	male	28.000	1	yes	southwest	23568.272000
53	36	male	34.430	0	yes	southeast	37742.575700
54	40	female	28.690	3	no	northwest	8059.679100
55	58	male	36.955	2	yes	northwest	47496.494450
56	58	female	31.825	2	no	northeast	13607.368750

In [77]:
```
df.shape
```

Out[77]:
```
(1338, 7)
```

In [78]:
```
df['region'].value_counts()
```

Out[78]:
```
region
southeast    364
southwest    325
northwest    325
northeast    324
Name: count, dtype: int64
```

In [79]:
```
df['bmi'].value_counts()
```

```
25.800     7
32.775     7
27.645     7
32.110     7
38.060     7
25.460     7
30.590     7
27.360     7
24.320     7
34.800     7
27.500     6
19.950     6
29.920     6
30.115     6
26.600     6
30.200     6
35.530     6
33.630     6
28.595     6
37.100     6
```

In [80]:
```
m={"sex":{"female":1,"male":0}}
df=df.replace(m)
print(df)
```

```
40     24    1  26.600         0     no  northeast   3046.062000
41     31    1  36.630         2     no  southeast   4949.758700
42     41    0  21.780         1     no  southeast   6272.477200
43     37    1  30.800         2     no  southeast   6313.759000
44     38    0  37.050         1     no  northeast   6079.671500
45     55    0  37.300         0     no  southwest  20630.283510
46     18    1  38.665         2     no  northeast   3393.356350
47     28    1  34.770         0     no  northwest   3556.922300
48     60    1  24.530         0     no  southeast  12629.896700
49     36    0  35.200         1    yes  southeast  38709.176000
50     18    1  35.625         0     no  northeast   2211.130750
51     21    1  33.630         2     no  northwest   3579.828700
52     48    0  28.000         1    yes  southwest  23568.272000
53     36    0  34.430         0    yes  southeast  37742.575700
54     40    1  28.690         3     no  northwest   8059.679100
55     58    0  36.955         2    yes  northwest  47496.494450
56     58    1  31.825         2     no  northeast  13607.368750
57     18    0  31.680         2    yes  southeast  34303.167200
58     53    1  22.880         1    yes  southeast  23244.790200
```

In [81]:
```
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
```

In [82]:
```
from sklearn.ensemble import RandomForestClassifier
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
```

Out[82]:
```
RandomForestClassifier
RandomForestClassifier()
```

In [83]:
```
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 [86]:
```
from sklearn.model_selection import GridSearchCV
grid_search=GridSearchCV(estimator=rf,param_grid=params,cv=2,scoring="accuracy")
grid_search.fit(x_train,y_train)
```

Out[86]:
```
GridSearchCV
estimator: RandomForestClassifier
RandomForestClassifier
```

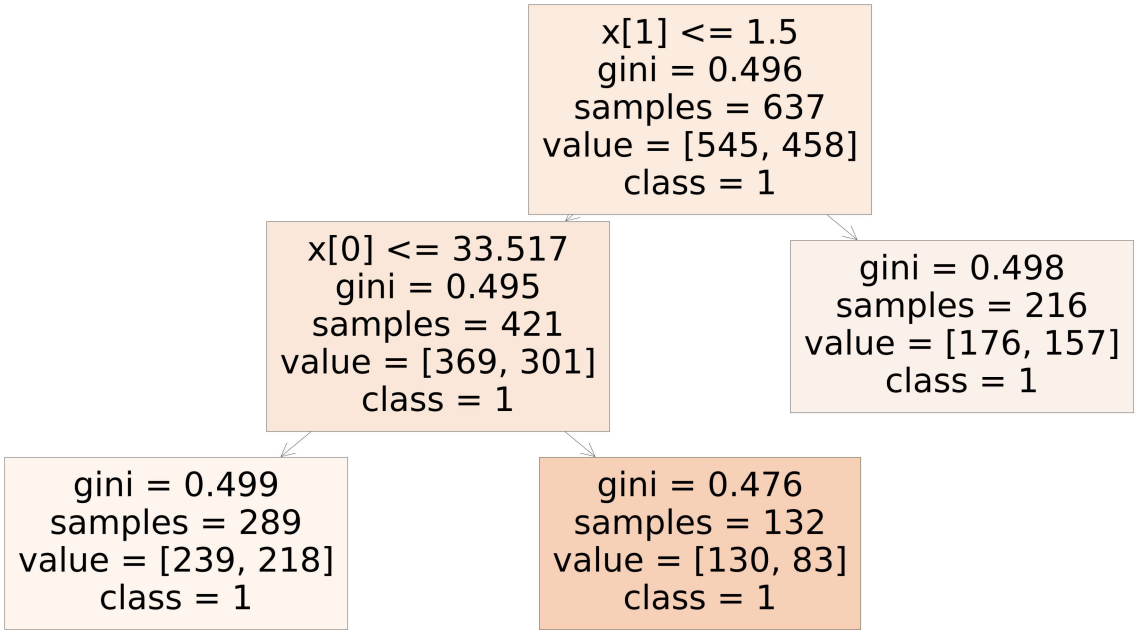
In [87]:
```
grid_search.best_score_
```

Out[87]:
```
0.5214451574937774
```

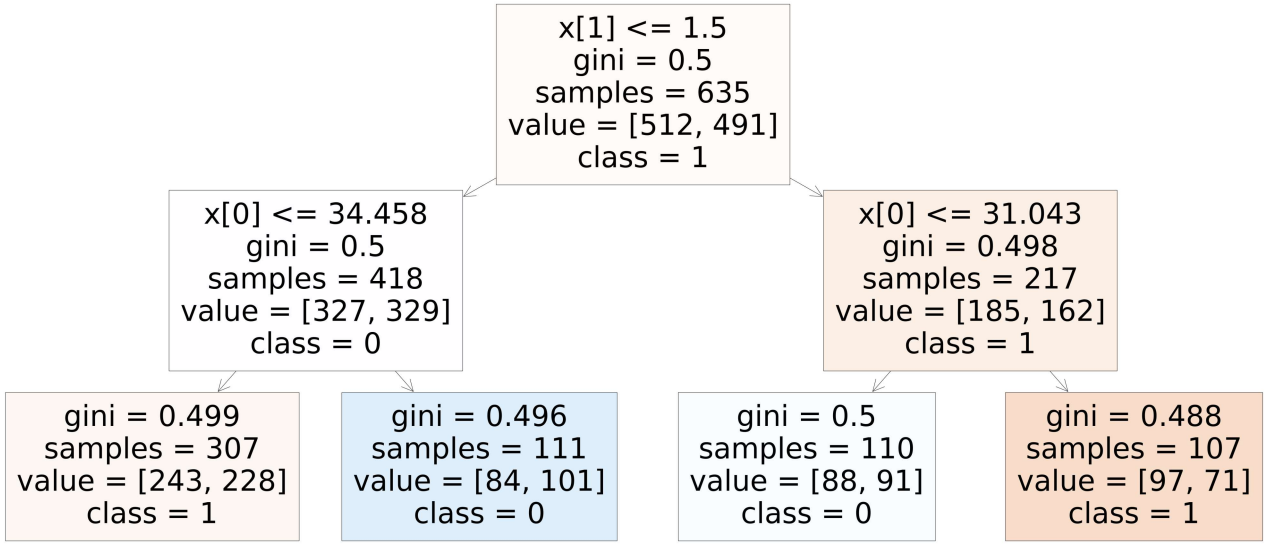
In [88]:
```
rf_best=grid_search.best_estimator_
print(rf_best)
```

```
RandomForestClassifier(max_depth=2, min_samples_leaf=100, n_estimators=50)
```

In [89]:
```
from sklearn.tree import plot_tree
plt.figure(figsize=(80,40))
plot_tree(rf_best.estimators_[4],class_names=['1','0'],filled=True);
```



In [90]:
```
from sklearn.tree import plot_tree
plt.figure(figsize=(70,30))
plot_tree(rf_best.estimators_[6],class_names=["1","0"],filled=True);
```



In [91]:
```
rf_best.feature_importances_
```

Out[91]:
```
array([0.75337435, 0.24662565])
```

In [92]:
```
rf=RandomForestClassifier(random_state=0)
```

In [93]:
```
rf.fit(x_train,y_train)
```

Out[93]:
```
RandomForestClassifier
RandomForestClassifier(random_state=0)
```

In [94]:
```
score=rf.score(x_test,y_test)
print(score)
```

```
0.46865671641791046
```

In [ ]: