Medical Insurance Cost Prediction Project

Explore the future of healthcare with our cutting-edge machine learning project, which predicts medical insurance costs with precision and empowers informed decisions for individuals and providers.

Improting The libraries

In [1]:
```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn import metrics
```

Data Collection & Analysis

In [2]:
```python
# loading the data from csv file to a Pandas DataFrame
```

In [3]:
```python
insurance_dataset = pd.read_csv('C:\\Users\\hp\\OneDrive\\Desktop\\insurance datafile.csv')
```

In [4]:
```python
# first 5 rows of the dataframe
insurance_dataset.head()
```

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

In [5]:
```python
#Original Insurance Dataset
insurance_dataset
```

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
...	...	...	...	...	...	...	...
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 [6]:
```python
# number of rows and columns
insurance_dataset.shape
```

Out[6]:
```
(1338, 7)
```

In [7]:
```python
# Statistical Analysis of our Dataset
```

In [8]:
```python
insurance_dataset.std()
```

```
C:\Users\hp\AppData\Local\Temp\ipykernel_11780\937511102.py:1: FutureWarning: The default value of numeric_only in DataFrame.std is deprecated. In a future version, it will default to False. In addition, specifying 'numeric_only=None' is deprecated. Select only valid columns or specify the value of numeric_only to silence this warning.
  insurance_dataset.std()
```

Out[8]:
```
age            14.049960
bmi             6.098187
children        1.205493
charges     12110.011237
dtype: float64
```

In [9]:
```python
# getting some informations about the dataset
insurance_dataset.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 [10]:
```python
# Categorical Features:

#Sex
#Smoker
#Region
```

In [11]:
```python
# checking for missing values
insurance_dataset.isnull().sum()
```

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

Data Analysis

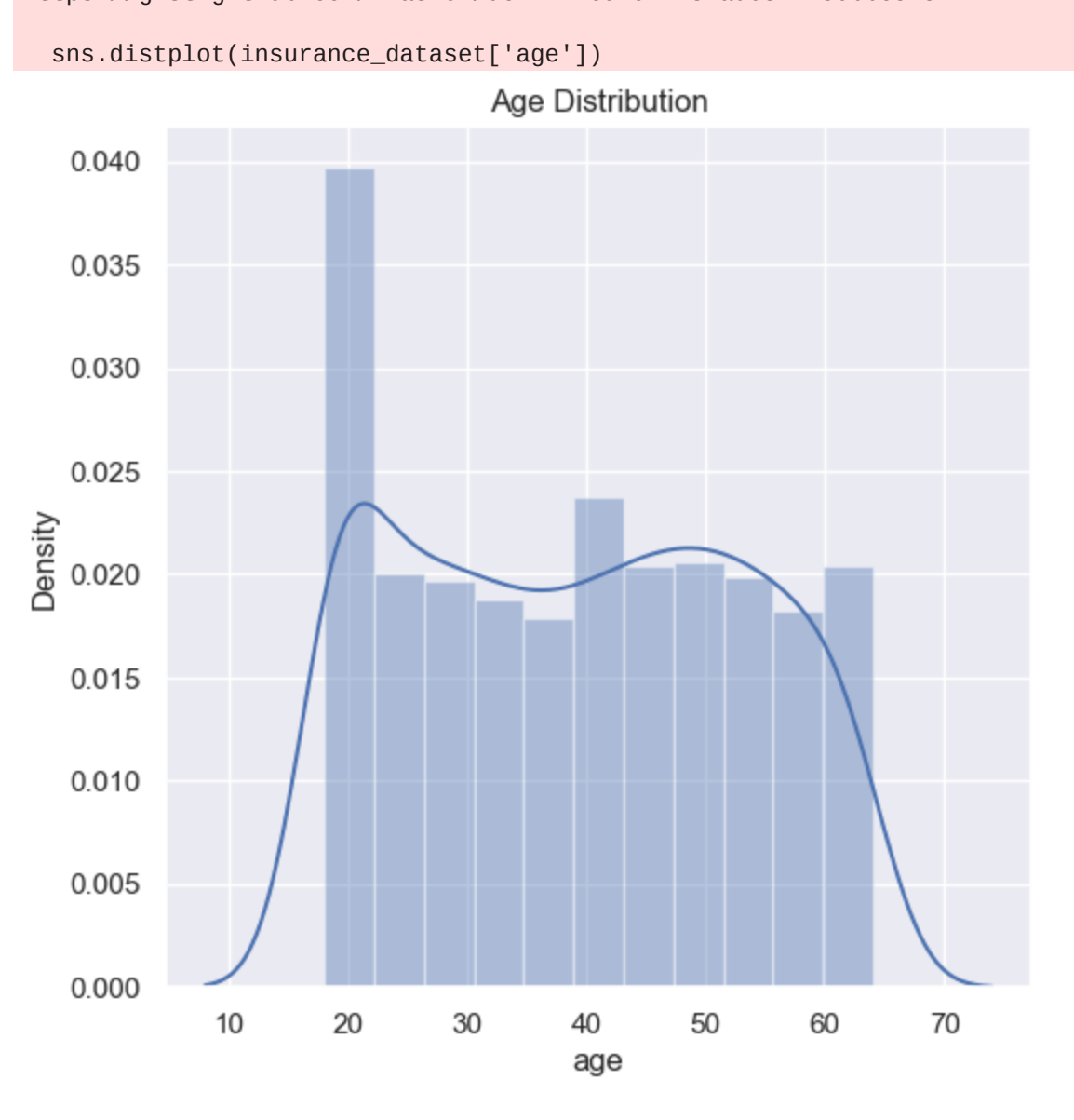
In [12]:
```python
# statistical Measures of the dataset
insurance_dataset.describe()
```

Out[12]:

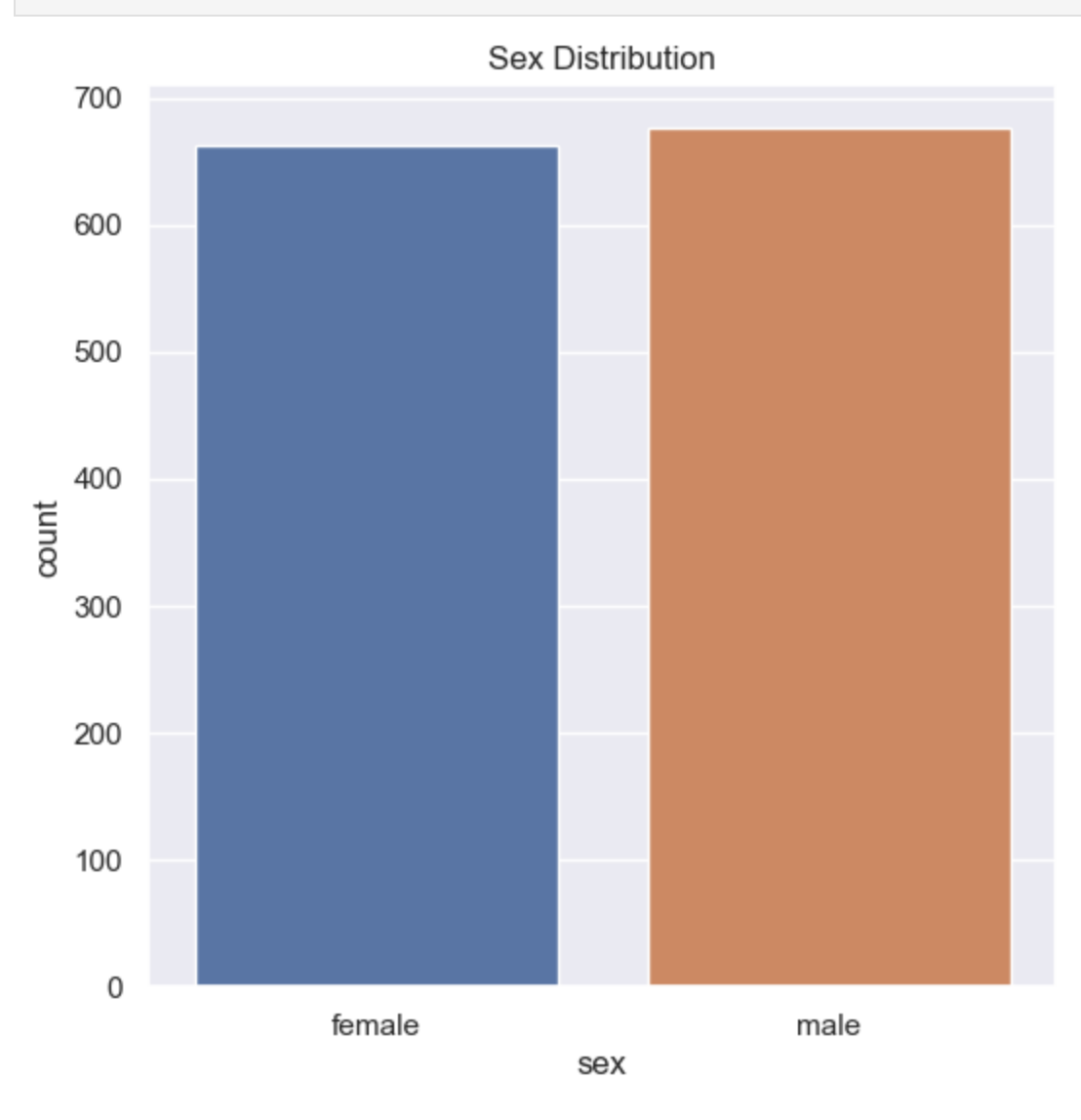
	age	bmi	children	charges
count	1338.000000	1338.000000	1338.000000	1338.000000
mean	39.207025	30.663397	1.094918	13270.422265
std	14.049960	6.098187	1.205493	12110.011237
min	18.000000	15.960000	0.000000	1121.873900
25%	27.000000	26.296250	0.000000	4740.287150
50%	39.000000	30.400000	1.000000	9382.033000
75%	51.000000	34.693750	2.000000	16639.912515
max	64.000000	53.130000	5.000000	63770.428010

In [13]:
```python
# distribution of age value
sns.set()
plt.figure(figsize=(6,6))
sns.distplot(insurance_dataset['age'])
plt.title('Age Distribution')
plt.show()
```

```
C:\Users\hp\AppData\Local\Temp\ipykernel_11780\3634923312.py:4: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(insurance_dataset['age'])
```



In [14]:
```python
# Gender column
plt.figure(figsize=(6,6))
sns.countplot(x='sex', data=insurance_dataset)
plt.title('Sex Distribution')
plt.show()
```

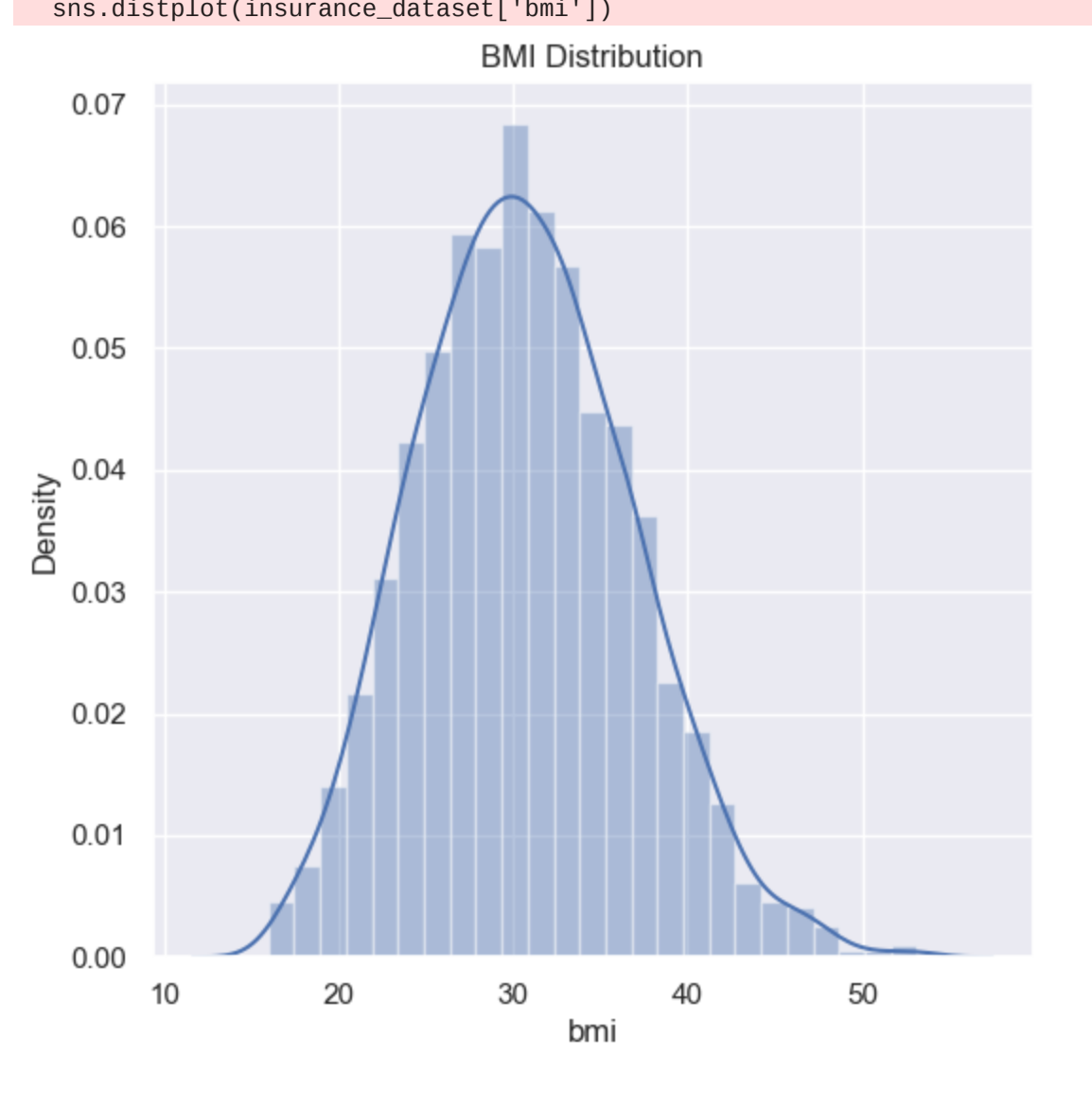


In [15]:
```python
insurance_dataset['sex'].value_counts()
```

Out[15]:
```
male      676
female    662
Name: sex, dtype: int64
```

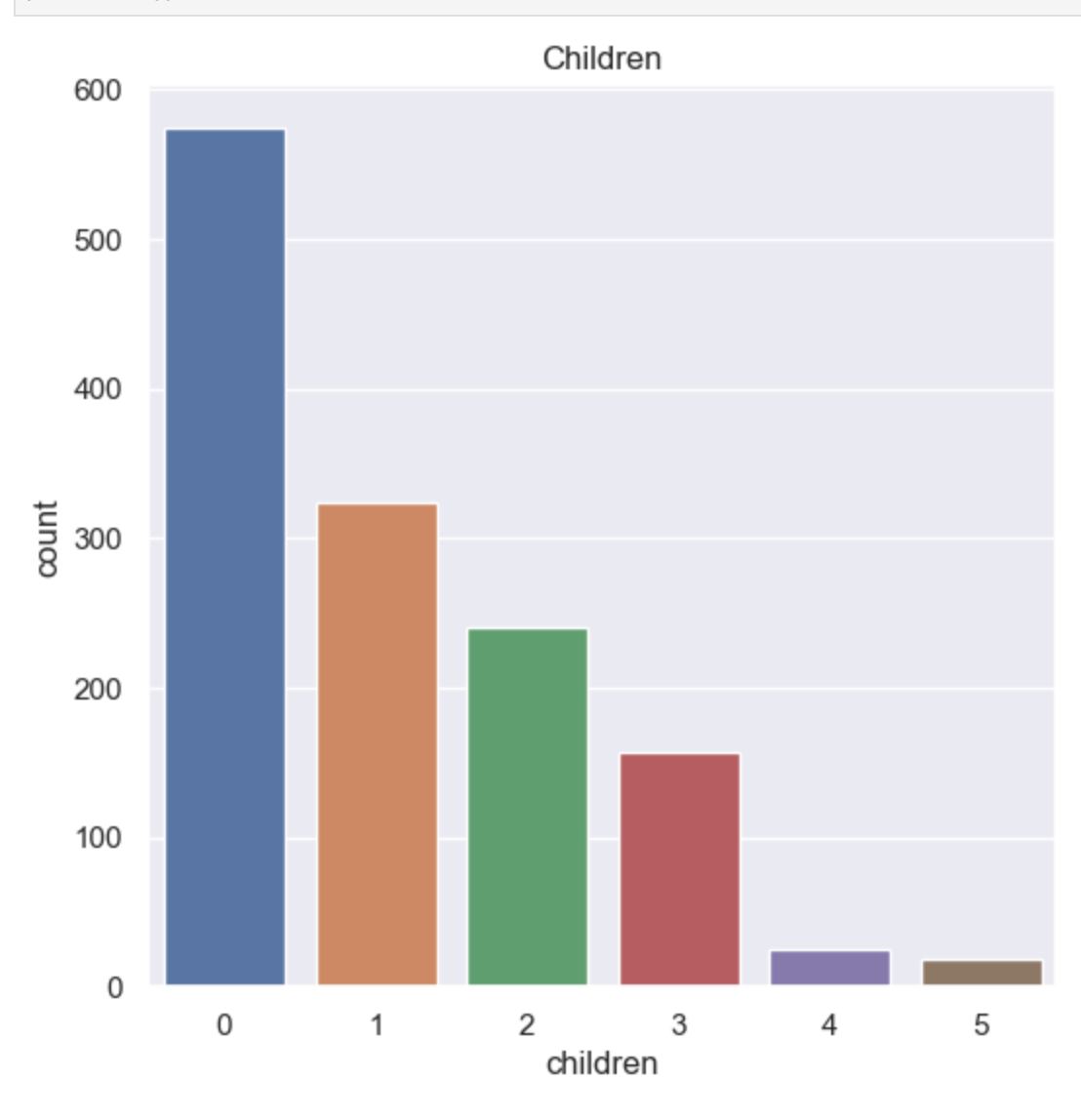
In [16]:
```python
# bmi distribution
plt.figure(figsize=(6,6))
sns.distplot(insurance_dataset['bmi'])
plt.title('BMI Distribution')
plt.show()
```

```
C:\Users\hp\AppData\Local\Temp\ipykernel_11780\1916795400.py:3: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(insurance_dataset['bmi'])
```



Normal BMI Range --> 18.5 to 24.9

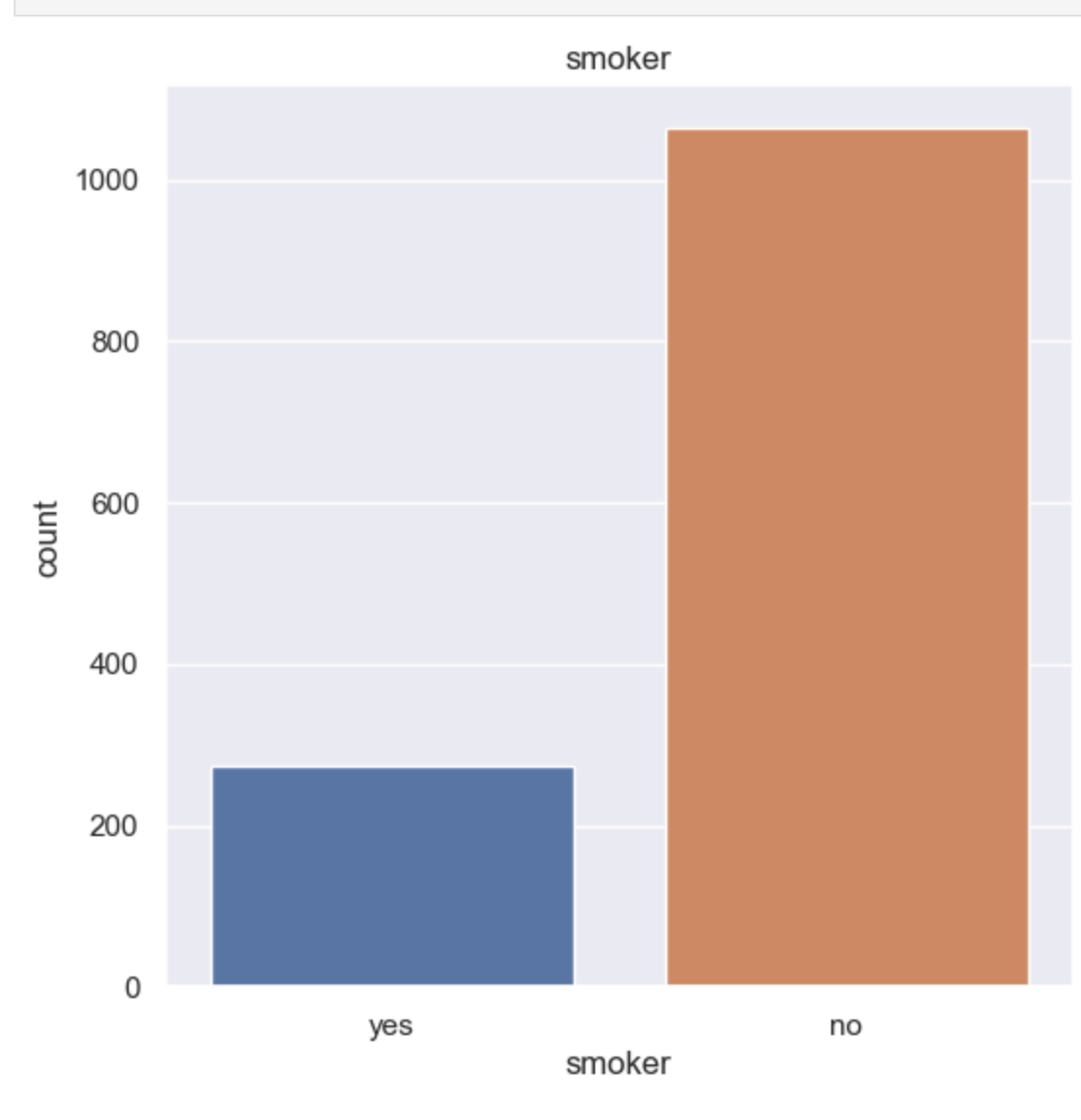
In [17]:
```python
# children column
plt.figure(figsize=(6,6))
sns.countplot(x='children', data=insurance_dataset)
plt.title('Children')
plt.show()
```



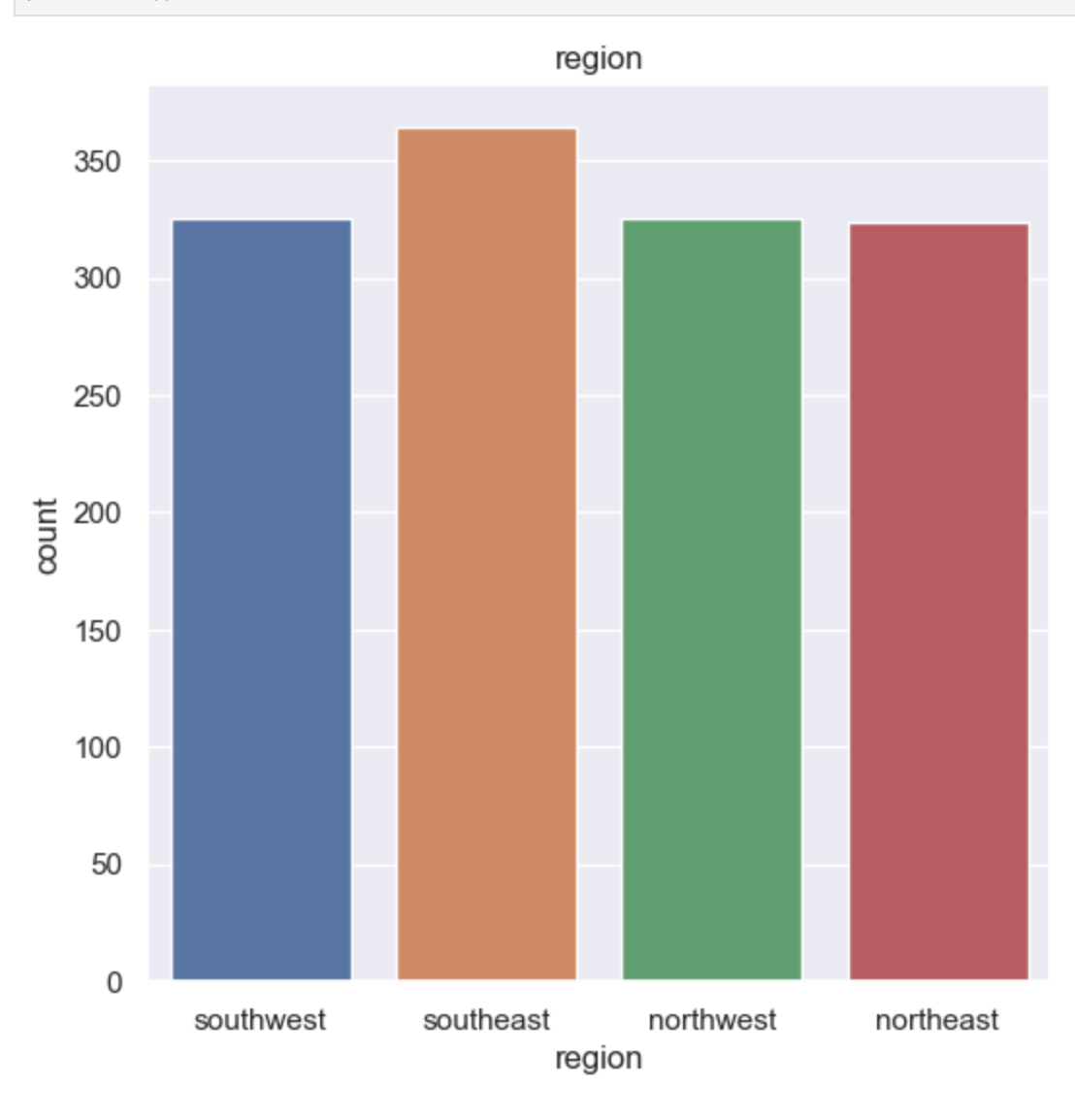
In [18]:
```python
insurance_dataset['children'].value_counts()
```

Out[18]:
```
0    574
1    324
2    240
3    157
4     25
5     18
Name: children, dtype: int64
```

In [19]:
```python
# smoker column
plt.figure(figsize=(6,6))
sns.countplot(x='smoker', data=insurance_dataset)
plt.title('smoker')
plt.show()
```



In [20]:
```python
# region column
plt.figure(figsize=(6,6))
sns.countplot(x='region', data=insurance_dataset)
plt.title('region')
plt.show()
```

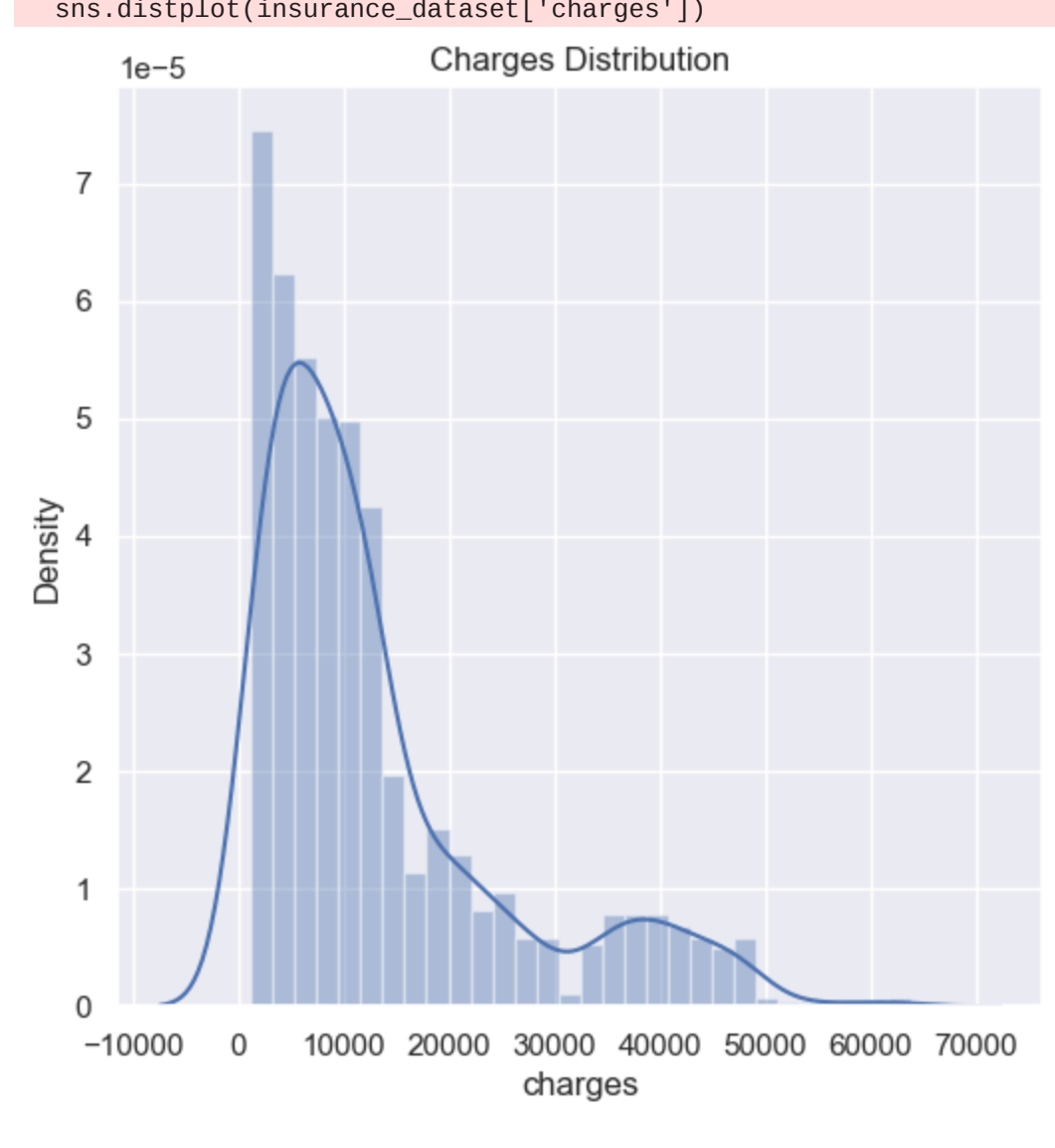


In [21]:
```python
insurance_dataset['region'].value_counts()
```

Out[21]:
```
southeast    364
southwest    325
northwest    325
northeast    324
Name: region, dtype: int64
```

In [22]:
```python
# distribution of charges value
plt.figure(figsize=(6,6))
sns.distplot(insurance_dataset['charges'])
plt.title('Charges Distribution')
plt.show()
```

```
C:\Users\hp\AppData\Local\Temp\ipykernel_11780\3971177022.py:3: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(insurance_dataset['charges'])
```



Data Pre-Processing

Encoding the categorical features

In [23]:
```python
# encoding sex column
insurance_dataset.replace({'sex':{'male':0,'female':1}}, inplace=True)

3 # encoding 'smoker' column
insurance_dataset.replace({'smoker':{'yes':0,'no':1}}, inplace=True)

# encoding 'region' column
insurance_dataset.replace({'region':{'southeast':0,'southwest':1,'northeast':2,'northwest':3}}, inplace=True)
```

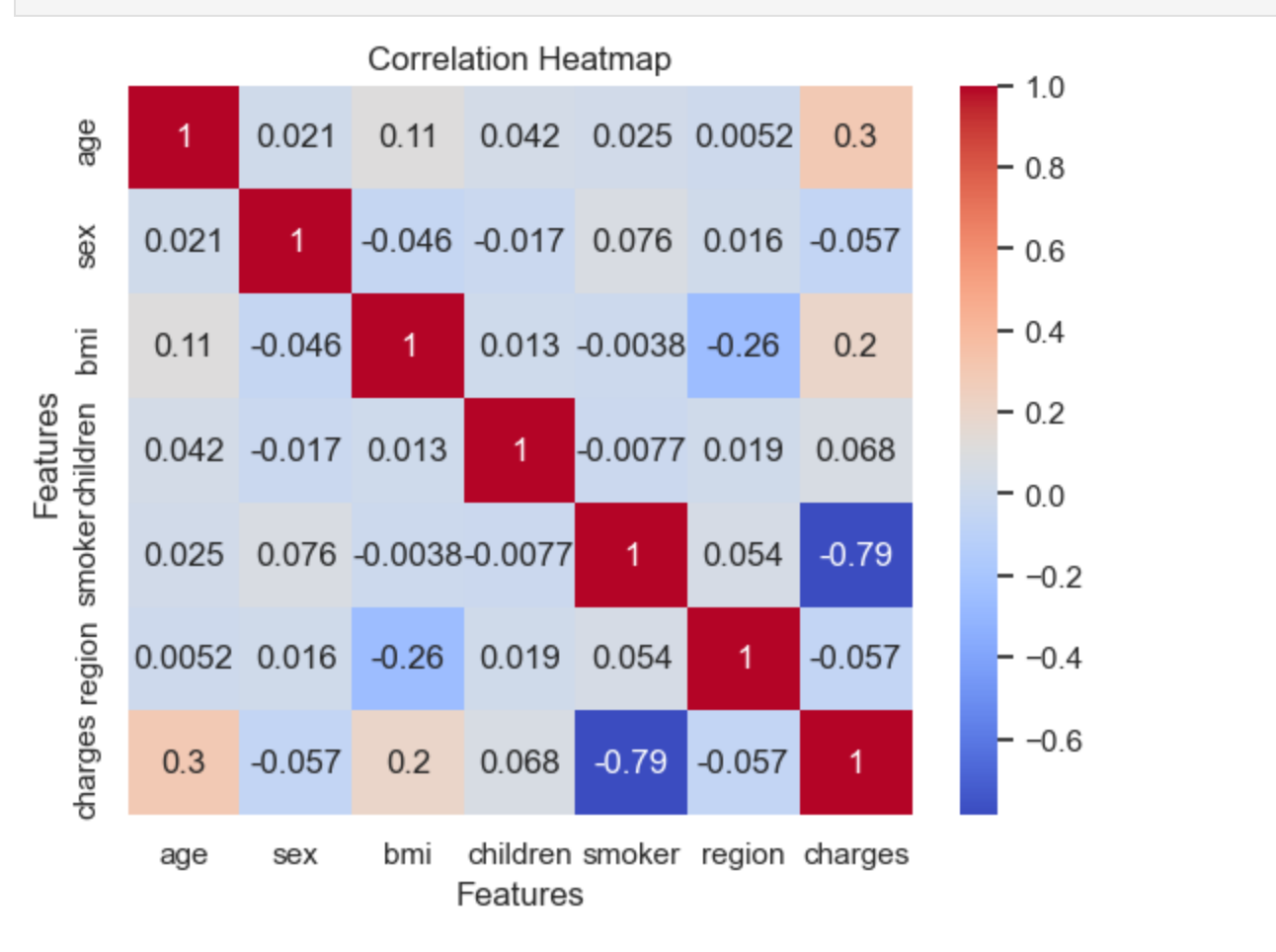
In [24]:
```python
insurance_dataset
```

Out[24]:

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

1338 rows × 7 columns

In [40]:
```python
# Assuming insurance_dataset is a Pandas DataFrame
correlation_matrix = insurance_dataset.corr()

# Create a heatmap of the correlation matrix
sns.heatmap(correlation_matrix, annot=True, cmap="coolwarm")

# Set plot labels and title
plt.xlabel("Features")
plt.ylabel("Features")
plt.title("Correlation Heatmap")

# Display the heatmap
plt.show()
```



Splitting the Features and Target

In [25]:
```python
X = insurance_dataset.drop(columns='charges', axis=1)
Y = insurance_dataset['charges']
```

In [26]:
```python
print(X)
```

```
      age  sex     bmi  children  smoker  region
0      19    1  27.900         0       0       1
1      18    0  33.770         1       1       0
2      28    0  33.000         3       1       0
3      33    0  22.705         0       1       3
4      32    0  28.880         0       1       3
...   ...  ...     ...       ...     ...     ...
1333   50    0  30.970         3       1       3
1334   18    1  31.920         0       1       2
1335   18    1  36.850         0       1       0
1336   21    1  25.800         0       1       1
1337   61    1  29.070         0       0       3

[1338 rows x 6 columns]
```

In [27]:
```python
print(Y)
```

```
0       16884.92400
1        1725.55230
2        4449.46200
3       21984.47061
4        3866.85520
           ...
1333    10600.54830
1334     2205.98080
1335     1629.83350
1336     2007.94500
1337    29141.36030
Name: charges, Length: 1338, dtype: float64
```

Splitting the data into Training data & Testing Data

In [28]:
```python
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.2, random_state=2)
```

In [29]:
```python
print(X.shape, X_train.shape, X_test.shape)
```

```
(1338, 6) (1070, 6) (268, 6)
```

Model Training

Linear Regression

In [30]:
```python
# loading the Linear Regression model
regressor = LinearRegression()
```

In [31]:
```python
regressor.fit(X_train, Y_train)
```

Out[31]:
```
▾ LinearRegression
LinearRegression()
```

Model Evaluation

In [32]:
```python
# prediction on training data
training_data_prediction =regressor.predict(X_train)
```

In [33]:
```python
# R squared value
r2_train = metrics.r2_score(Y_train, training_data_prediction)
print('R squared vale : ', r2_train)
```

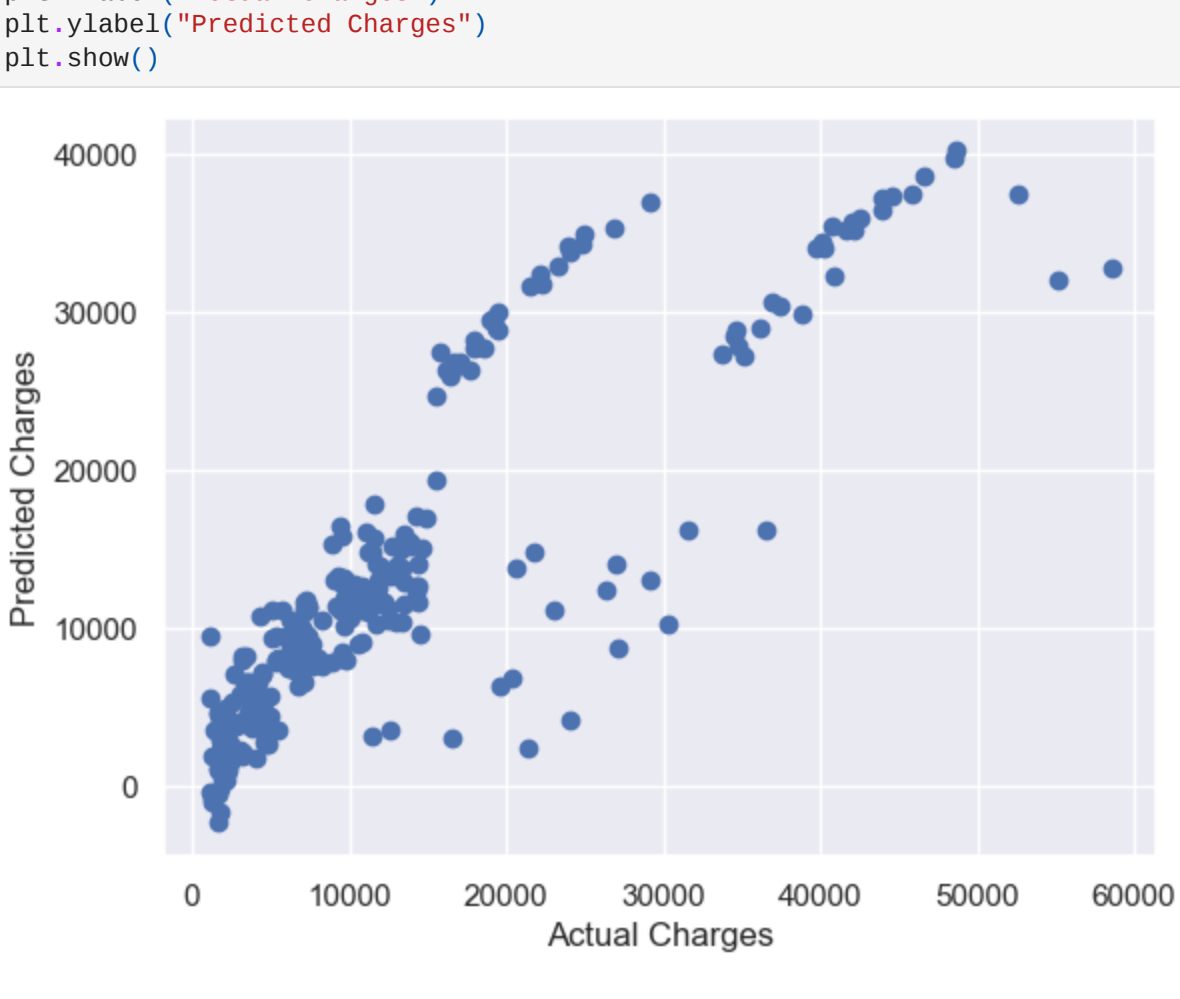
```
R squared vale :  0.751505643411174
```

In [34]:
```python
# prediction on test data
test_data_prediction =regressor.predict(X_test)
```

In [35]:
```python
# R squared value
r2_test = metrics.r2_score(Y_test, test_data_prediction)
print('R squared vale : ', r2_test)
```

```
R squared vale :  0.7447273869684077
```

In [45]:
```python
plt.scatter(Y_test ,test_data_prediction)

plt.xlabel("Actual Charges")
plt.ylabel("Predicted Charges")
plt.show()
```



Building a Predictive System

In [46]:
```python
input_data = (31,1,25.74,0,1,0)

# changing input_data to a numpy array
input_data_as_numpy_array = np.asarray(input_data)

# reshape the array
input_data_reshaped = input_data_as_numpy_array.reshape(1,-1)

prediction = regressor.predict(input_data_reshaped)
print(prediction)

print('The insurance cost is USD ', prediction[0])
```

```
[3760.0805765]
The insurance cost is USD  3760.0805764960487
C:\Users\hp\anaconda3\Lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature names, but LinearRegression was fitted with feature names
  warnings.warn(
```

In [ ]: