Problem Statement: Developing an Automated Health Insurance Cost Prediction System for a Medical Company

Context and Company Vision:

- The healthcare industry is undergoing significant changes and advancements.
- Our medical company aims to improve operational efficiency and customer experience.
- We plan to achieve this by implementing an advanced automation system.

Primary Objective:

- Develop a predictive model capable of accurately estimating health insurance costs.
- The focus is on individual policyholders, tailoring predictions to their specific circumstances.

Work Flow

- **Data Collection**
- **Data Preprocessing**
- **Feature Engineering**
- **Data Splitting and Validation**
- **Model Training**
- **Model Evaluation**

Importing Dependencies

In [1]:

```
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 and Analysis

In [2]:

```
insurance_data = pd.read_csv('insurance.csv')
insurance_data.head()
```

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

In [3]:

```
insurance_data.shape #rows and columns
```

Out[3]:

```
(1338, 7)
```

In [4]:

```
insurance_data.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 [5]:

```
insurance_data.isnull().sum() #checking for missing values presence
```

Out[5]:

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

In [6]:

```
#statistical analysis of data
insurance_data.describe()
```

Out[6]:

	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

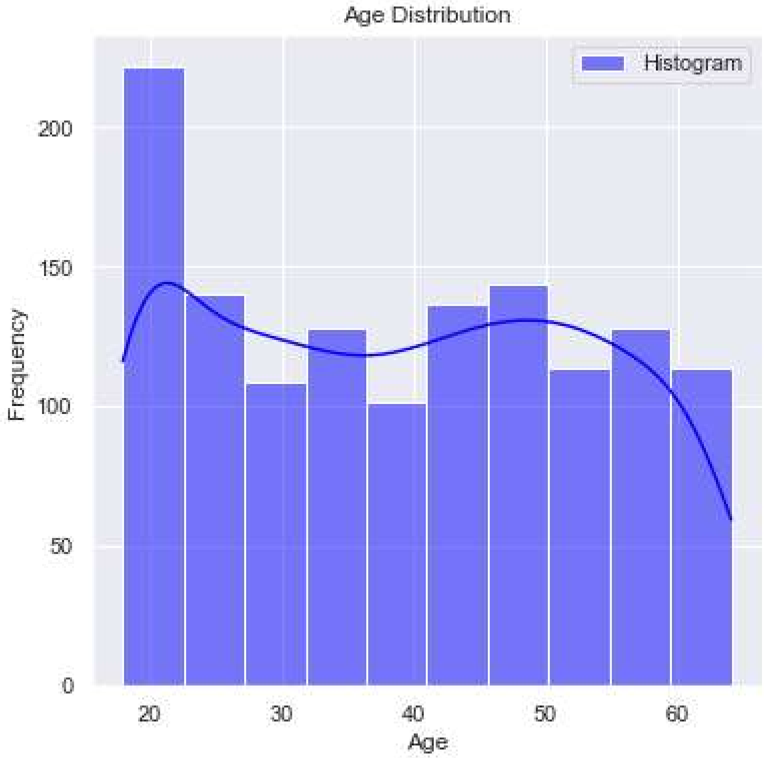
In [7]:

```
import warnings
from sklearn.exceptions import ConvergenceWarning

warnings.filterwarnings("ignore", category=DeprecationWarning)
warnings.filterwarnings("ignore", category=ConvergenceWarning)
```

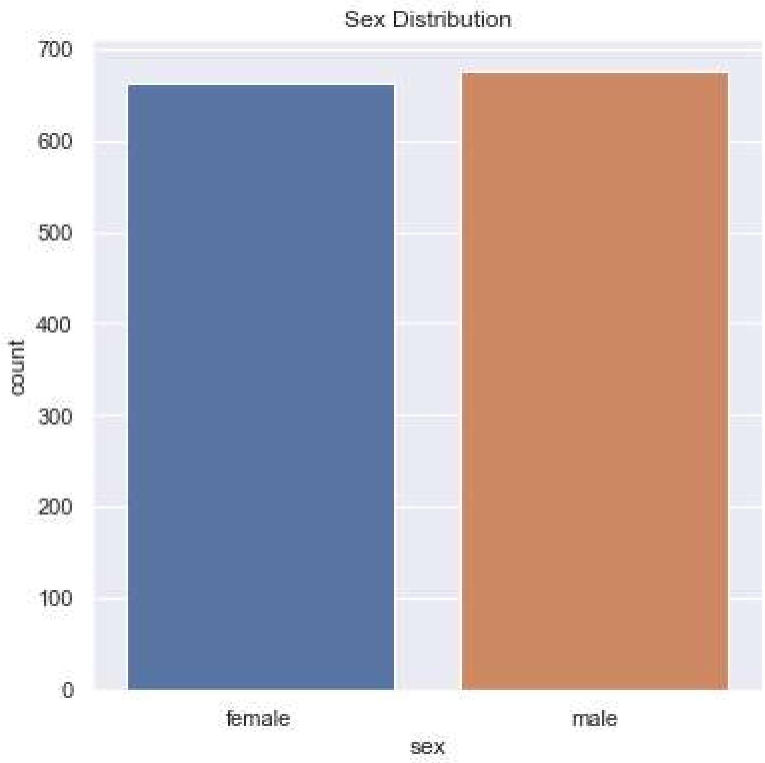
In [18]:

```
sns.set()
plt.figure(figsize=(6, 6))
age_data = insurance_data['age']
# Create histogram
sns.histplot(data=age_data, bins=10, kde=True, color='blue', label='Histogram')
plt.title('Age Distribution')
plt.xlabel('Age')
plt.ylabel('Frequency')
plt.legend()
plt.show()
```



In [22]:

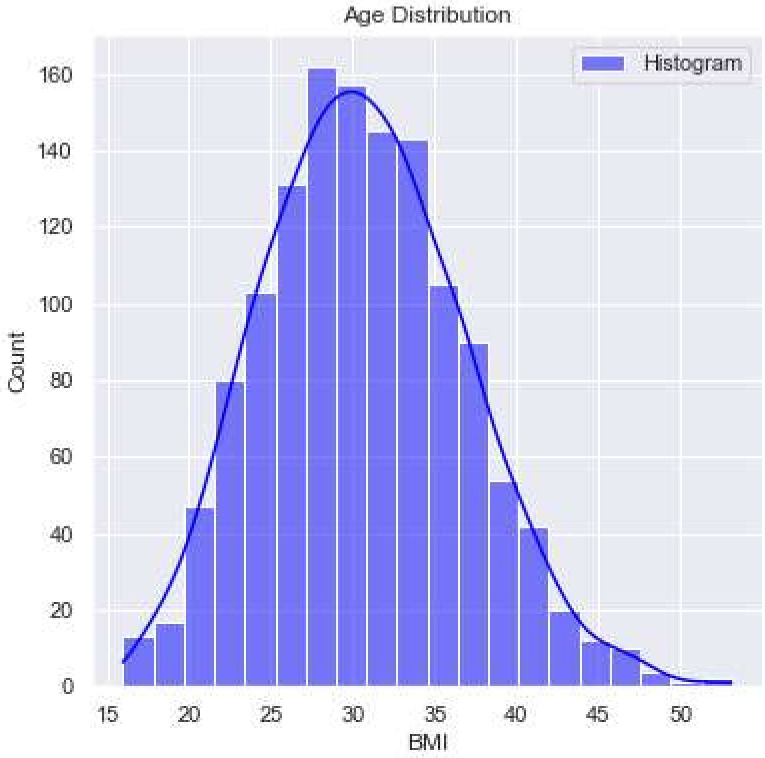
```
plt.figure(figsize=(6, 6))
sns.countplot(x='sex', data=insurance_data)
plt.title('Sex Distribution')
plt.show()
```



Sex Distribution

In [26]:

```
sns.set()
plt.figure(figsize=(6, 6))
age_data = insurance_data['bmi']
# Create histogram
sns.histplot(data=age_data, bins=20, kde=True, color='blue', label='Histogram')
plt.title('Age Distribution')
plt.xlabel('BMI')
plt.ylabel('Count')
plt.legend()
plt.show()
```

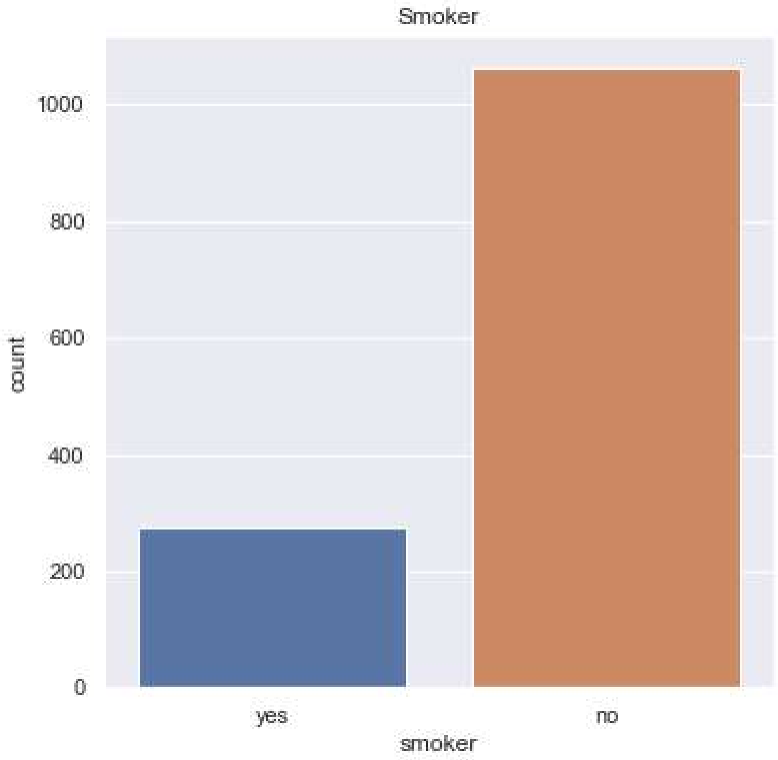


Normal BMI --> 18.5 to 24.9

Lot of people having BMI More than 24.9 , that affects their health premium

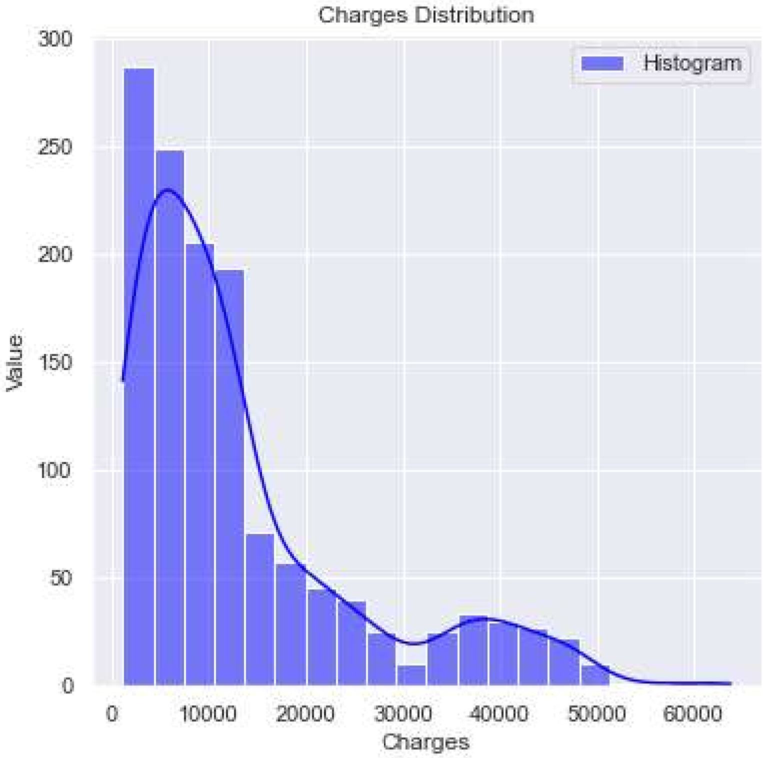
In [27]:

```
plt.figure(figsize=(6, 6))
sns.countplot(x='smoker', data=insurance_data)
plt.title('Smoker')
plt.show()
```



In [28]:

```
#Charges Distribution
sns.set()
plt.figure(figsize=(6, 6))
age_data = insurance_data['charges']
# Create histogram
sns.histplot(data=age_data, bins=20, kde=True, color='blue', label='Histogram')
plt.title('Charges Distribution')
plt.xlabel('Charges')
plt.ylabel('Value')
plt.legend()
plt.show()
```



Encoding Categorical Columns

In [29]:

```
insurance_data.replace({'sex':{'male':0, 'female':1}}, inplace = True)
insurance_data.replace({'smoker':{'yes':0, 'no':1}}, inplace = True)
insurance_data.replace({'region':{'southeast':0, 'southwest':1, 'northeast':2, 'northwest'
```

In [30]:

```
insurance_data.head()
```

Out[30]:

	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

Splitting Features and Target

In [31]:

```
X = insurance_data.drop(columns='charges', axis = 1)
y = insurance_data['charges']
```

In [32]:

```
X
```

Out[32]:

	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 × 6 columns

In [33]:

```
y
```

Out[33]:

```
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 data into train and test

In [34]:

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, random_state = 2
```

Model Training

In [36]:

```
regressor = LinearRegression()
regressor.fit(X_train, y_train)
```

Out[36]:

```
▾ LinearRegression
LinearRegression()
```

Model Evaluation

In [37]:

```
training_data_prediction  = regressor.predict(X_train)
```

In [38]:

```
# R Squared Value
r2_train = metrics.r2_score(y_train, training_data_prediction)
print(r2_train)
```

```
0.751505643411174
```

In [39]:

```
insurance_data.tail()
```

Out[39]:

	age	sex	bmi	children	smoker	region	charges
1333	50	0	30.97	3	1	3	10600.5483
1334	18	1	31.92	0	1	2	2205.9808
1335	18	1	36.85	0	1	0	1629.8335
1336	21	1	25.80	0	1	1	2007.9450
1337	61	1	29.07	0	0	3	29141.3603

Building a predictive System

In [46]:

```
input_data = (20, 1, 36.85, 0, 1, 2)
# Convert the tuple to a NumPy array
data_array = np.asarray(input_data)
# Reshape the array
reshaped_array = data_array.reshape(1, -1)  # Reshape into a 1*1 array
prediction = regressor.predict(reshaped_array)
prediction
```

Out[46]:

```
array([5092.55027764])
```