In [25]:
```
#import libraries
import numpy as np                # linear algebra
import pandas as pd               # data processing, read CSV file
import seaborn as sns             # data visualization
import matplotlib.pyplot as plt   # calculate plots
import missingno as msno          # calculate missing value
import plotly.graph_objects as go
import plotly.express as px
from plotly.offline import download_plotlyjs, init_notebook_mode, plot, iplot
from sklearn.cluster import KMeans
from sklearn.preprocessing import StandardScaler

init_notebook_mode(connected=True)
```

In [4]:
```
#data loading
df = pd.read_csv('WA_Fn-UseC_-Telco-Customer-Churn.csv')
df.shape
```

Out[4]:
```
(7043, 21)
```

In [5]:
```
#displaying column names
df.columns.values
```

Out[5]:
```
array(['customerID', 'gender', 'SeniorCitizen', 'Partner', 'Dependents',
       'tenure', 'PhoneService', 'MultipleLines', 'InternetService',
       'OnlineSecurity', 'OnlineBackup', 'DeviceProtection',
       'TechSupport', 'StreamingTV', 'StreamingMovies', 'Contract',
       'PaperlessBilling', 'PaymentMethod', 'MonthlyCharges',
       'TotalCharges', 'Churn'], dtype=object)
```

In [6]:
```
#info about data structure
df.info()
```

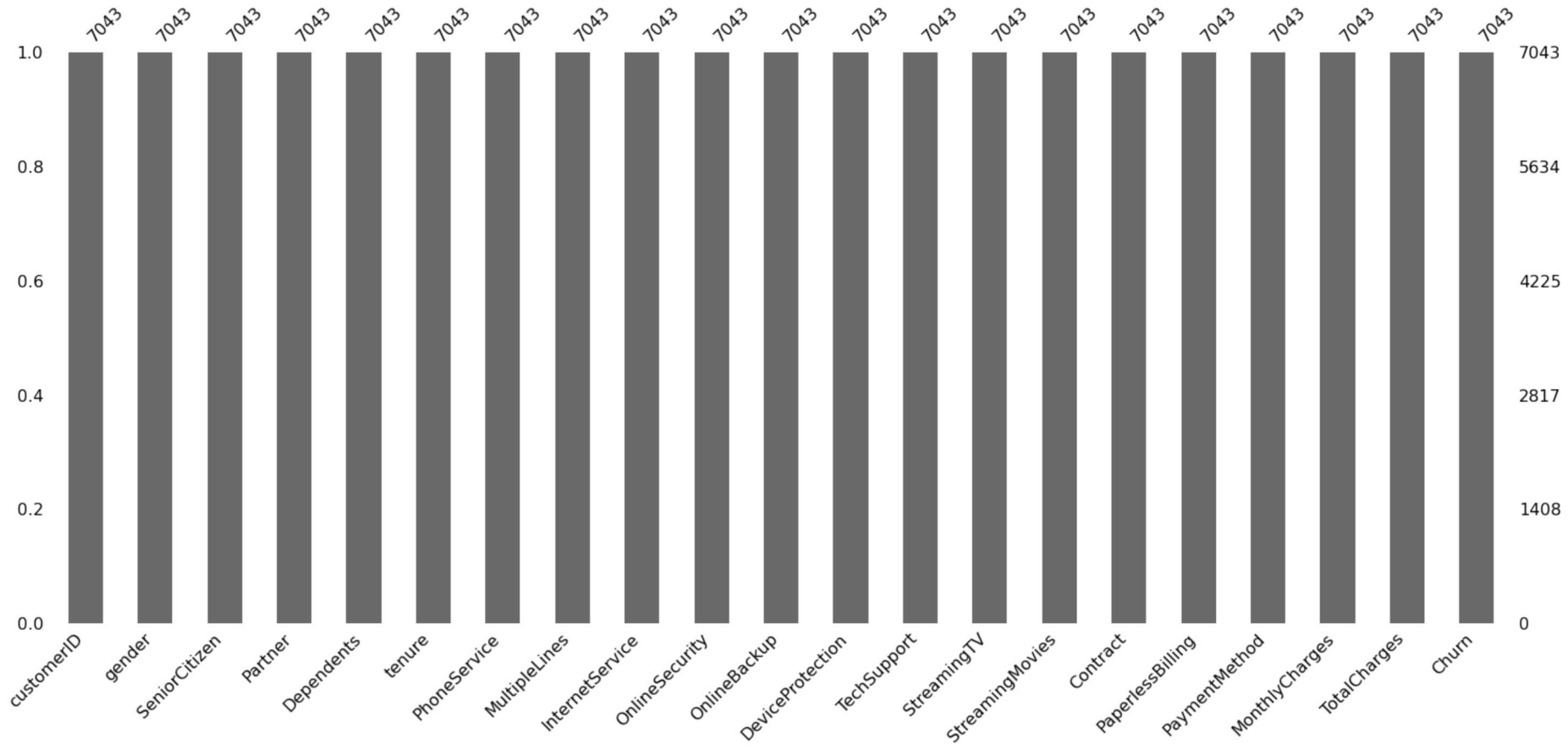
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7043 entries, 0 to 7042
Data columns (total 21 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   customerID        7043 non-null   object 
 1   gender            7043 non-null   object 
 2   SeniorCitizen     7043 non-null   int64  
 3   Partner           7043 non-null   object 
 4   Dependents        7043 non-null   object 
 5   tenure            7043 non-null   int64  
 6   PhoneService      7043 non-null   object 
 7   MultipleLines     7043 non-null   object 
 8   InternetService   7043 non-null   object 
 9   OnlineSecurity    7043 non-null   object 
 10  OnlineBackup      7043 non-null   object 
 11  DeviceProtection  7043 non-null   object 
 12  TechSupport       7043 non-null   object 
 13  StreamingTV       7043 non-null   object 
 14  StreamingMovies   7043 non-null   object 
 15  Contract          7043 non-null   object 
 16  PaperlessBilling  7043 non-null   object 
 17  PaymentMethod     7043 non-null   object 
 18  MonthlyCharges    7043 non-null   float64
 19  TotalCharges      7043 non-null   object 
 20  Churn             7043 non-null   object 
dtypes: float64(1), int64(2), object(18)
memory usage: 1.1+ MB
```

In [7]:
```
#info of data
df.describe()
```

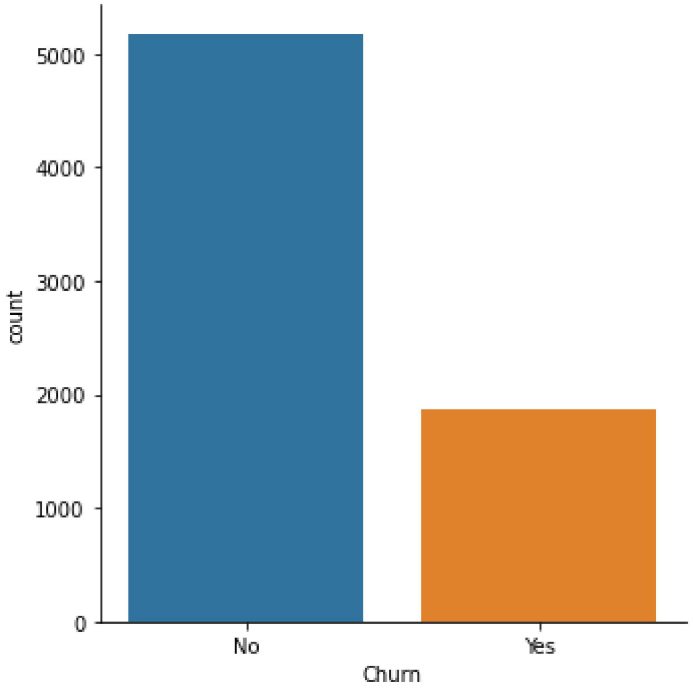
Out[7]:

	SeniorCitizen	tenure	MonthlyCharges
count	7043.000000	7043.000000	7043.000000
mean	0.162147	32.371149	64.761692
std	0.368612	24.559481	30.090047
min	0.000000	0.000000	18.250000
25%	0.000000	9.000000	35.500000
50%	0.000000	29.000000	70.350000
75%	0.000000	55.000000	89.850000
max	1.000000	72.000000	118.750000

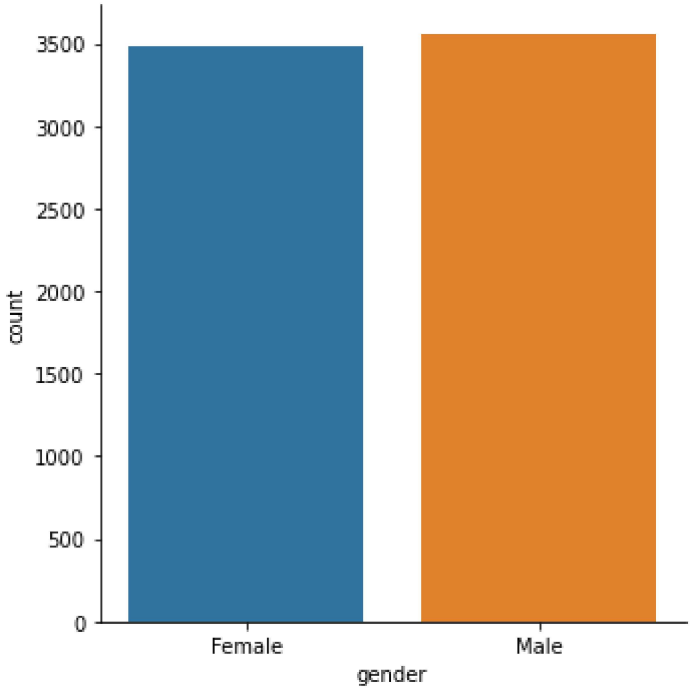
In [13]:
```
#identifying missing values by a bar
msno.bar(df)
plt.show()
```



In [18]:
```
#churn and non-churn Customers proportion
df['Churn'].value_counts()
sns.catplot(data=df, x="Churn", kind="count");
```



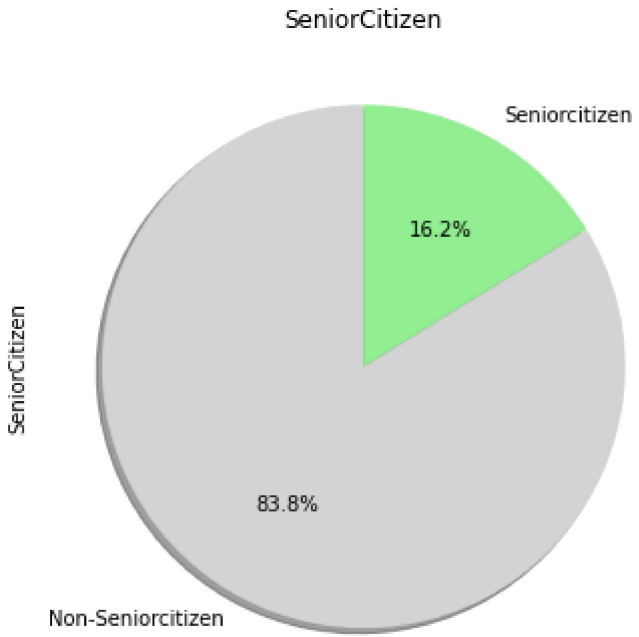
In [16]:
```
#distribution of gender
sns.catplot(data=df, x="gender", kind="count");
```



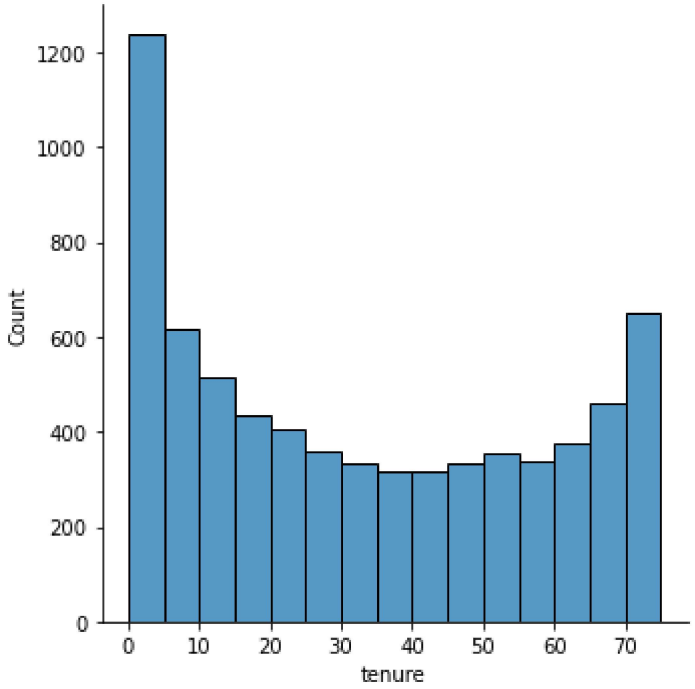
In [8]:
```
#creating separate dataset
#Churn yes dataset
churn_yes = pd.DataFrame(df.query('Churn == "Yes"'))
#Churn no dataset
churn_no = pd.DataFrame(df.query('Churn == "No"'))
```

In [9]:
```
#percentage of senior citizens in each of these dataframes
df['SeniorCitizen'].value_counts().plot(kind='pie',
                                        figsize=(8,6),
                                        colors = ['lightgrey', 'lightgreen'],
                                        autopct='%1.1f%%',
                                        shadow = True,
                                        startangle=90,
                                        labels=["Non-Seniorcitizen", "Seniorcitizen"])
plt.title("SeniorCitizen")
```

Out[9]:
```
Text(0.5, 1.0, 'SeniorCitizen')
```



In [95]:
```
#distribution of Tenure
sns.displot(df, x="tenure", binwidth=5);
```



In [104…

```
#distribution of Internet Service
InternetService=pd.DataFrame(churn_yes['InternetService'].value_counts().reset_index())
InternetService.rename(columns={'index':'InternetService_churn_yes','InternetService':'counts_yes'},inplace=True)
InternetService_no=pd.DataFrame(churn_no['InternetService'].value_counts().reset_index())
InternetService_no.rename(columns={'index':'InternetServicechurn_no','InternetService':'counts_no'},inplace=True)
InternetService_status=pd.concat([InternetService,InternetService_no],axis=1)
InternetService_status
```

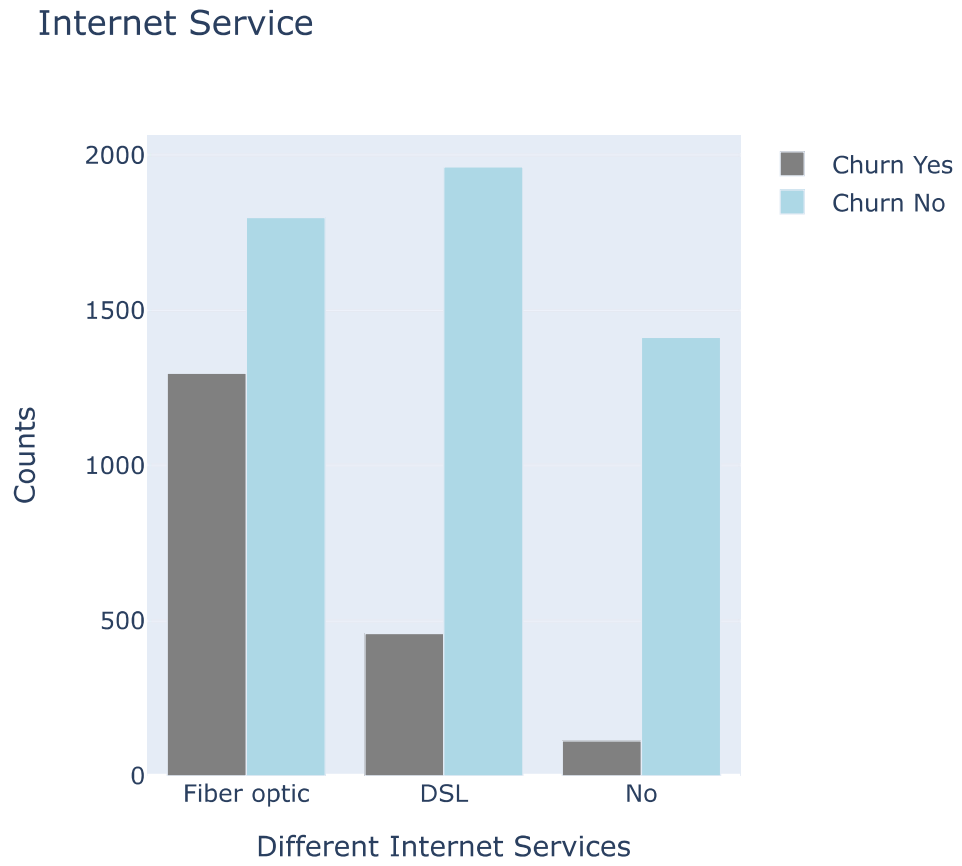
Out[104]:

	InternetService_churn_yes	counts_yes	InternetServicechurn_no	counts_no
0	Fiber optic	1297	DSL	1962
1	DSL	459	Fiber optic	1799
2	No	113	No	1413

In [32]:

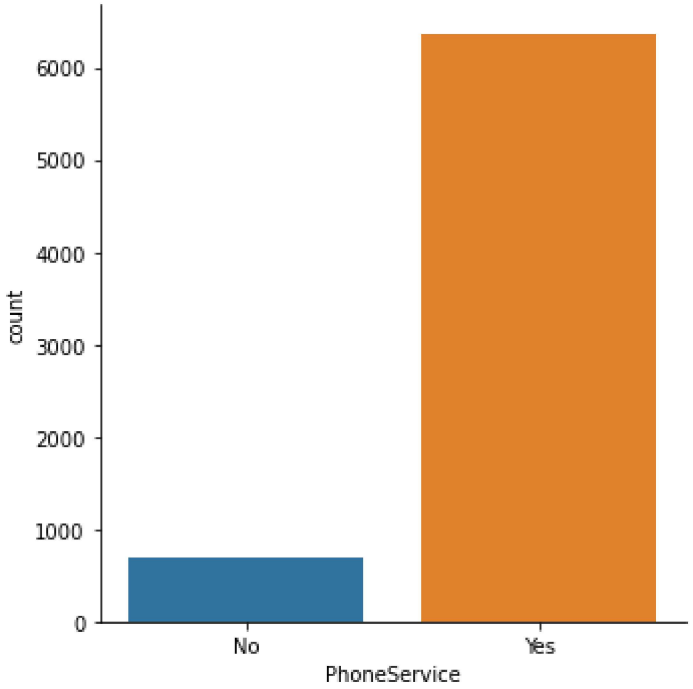
```
# Create the figure
fig = go.Figure()

# Churn Yes
```

```
fig.add_trace(go.Bar(name='Churn Yes',
                     x=['Fiber optic', 'DSL', 'No'],
                     y=[1297, 459, 113],
                     marker_color='grey'))

# Churn No
fig.add_trace(go.Bar(name='Churn No',
                     x=['Fiber optic', 'DSL', 'No'],
                     y=[1799, 1962, 1413],
                     marker_color='lightblue'))

# Update the layout
fig.update_layout(title='Internet Service',
                  autosize=False,
                  width=500,
                  height=500,
                  barmode='group')

# Update the axes
fig.update_xaxes(title='Different Internet Services')
fig.update_yaxes(title='Counts')

# Save the plot as an image file (when import as Jupyter notebook plot disappears)
fig.write_image("internet_service.png")

# Display the figure
fig.show()
```

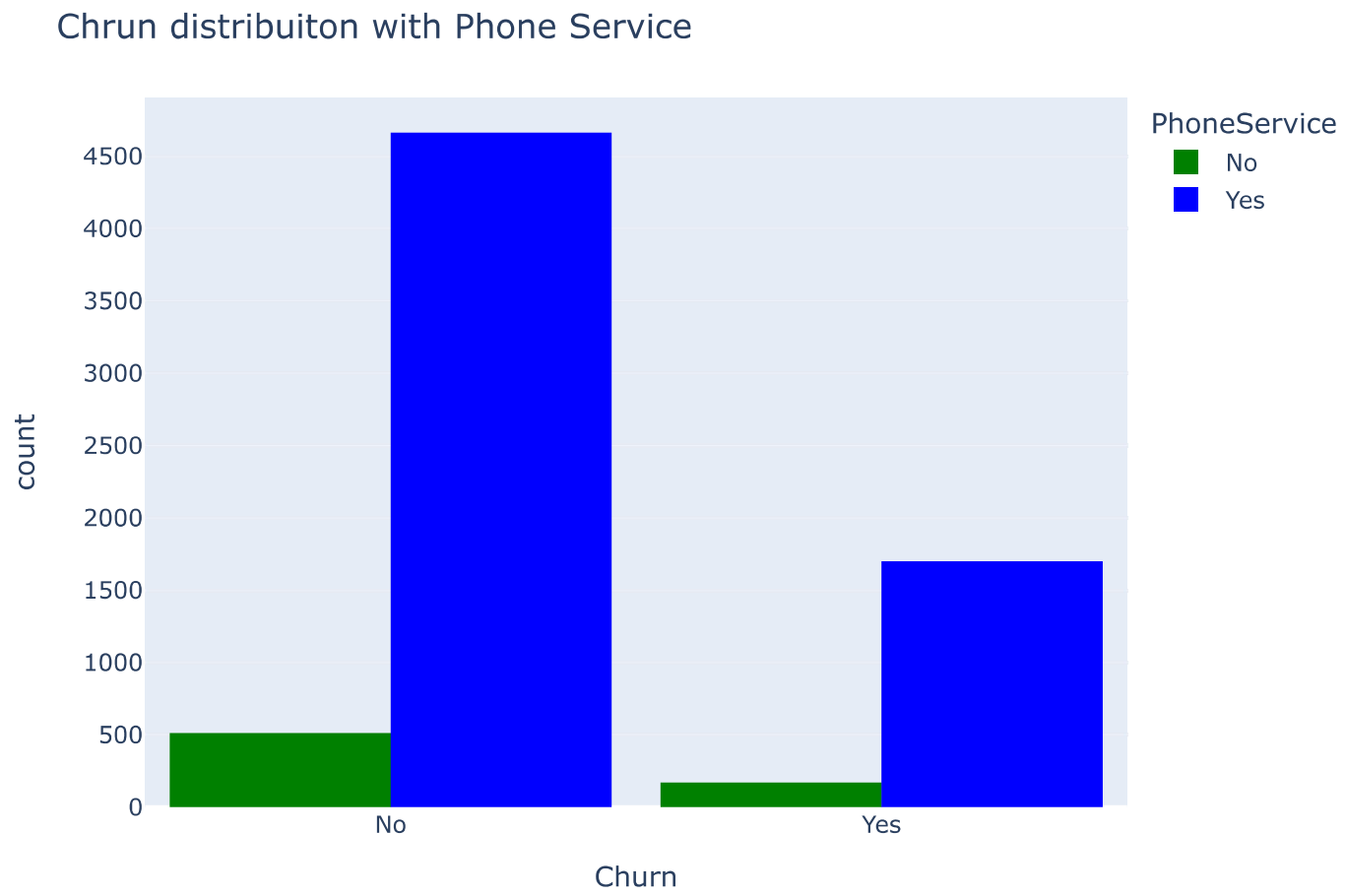


In [121…

```
#distribution of PhoneService
sns.catplot(data=df, x="PhoneService", kind="count");
```

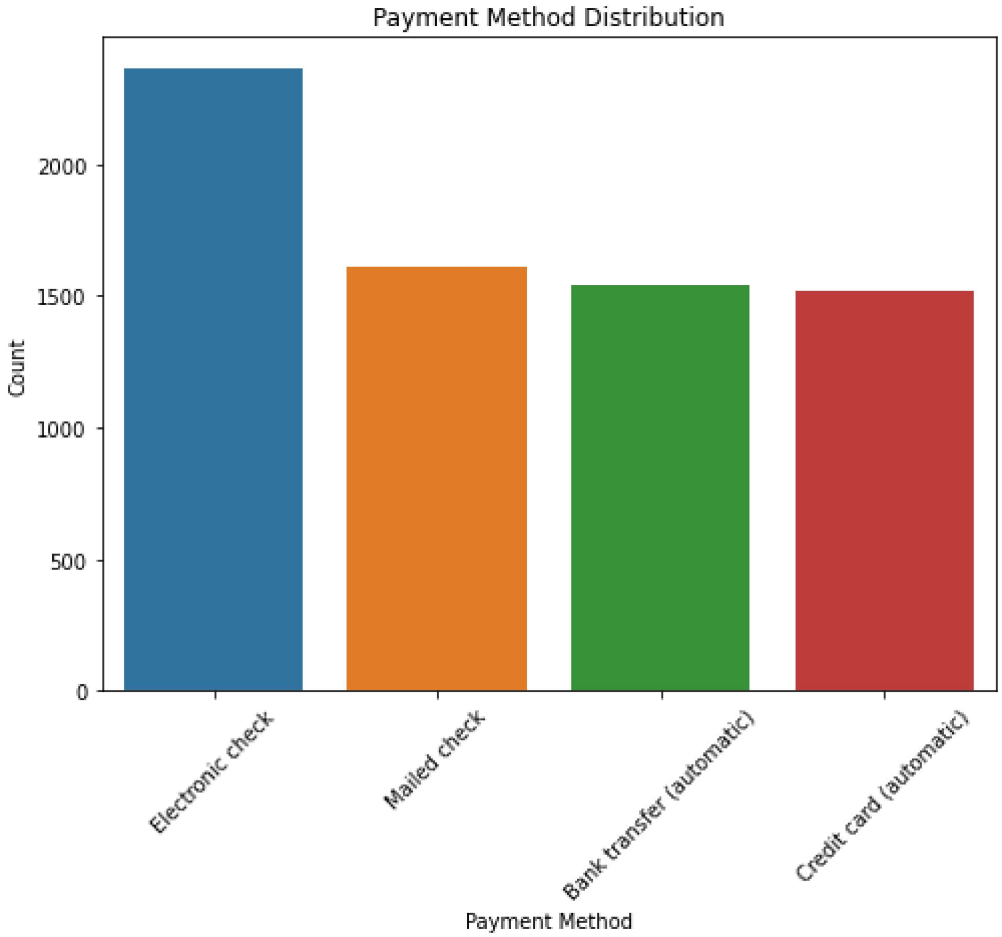


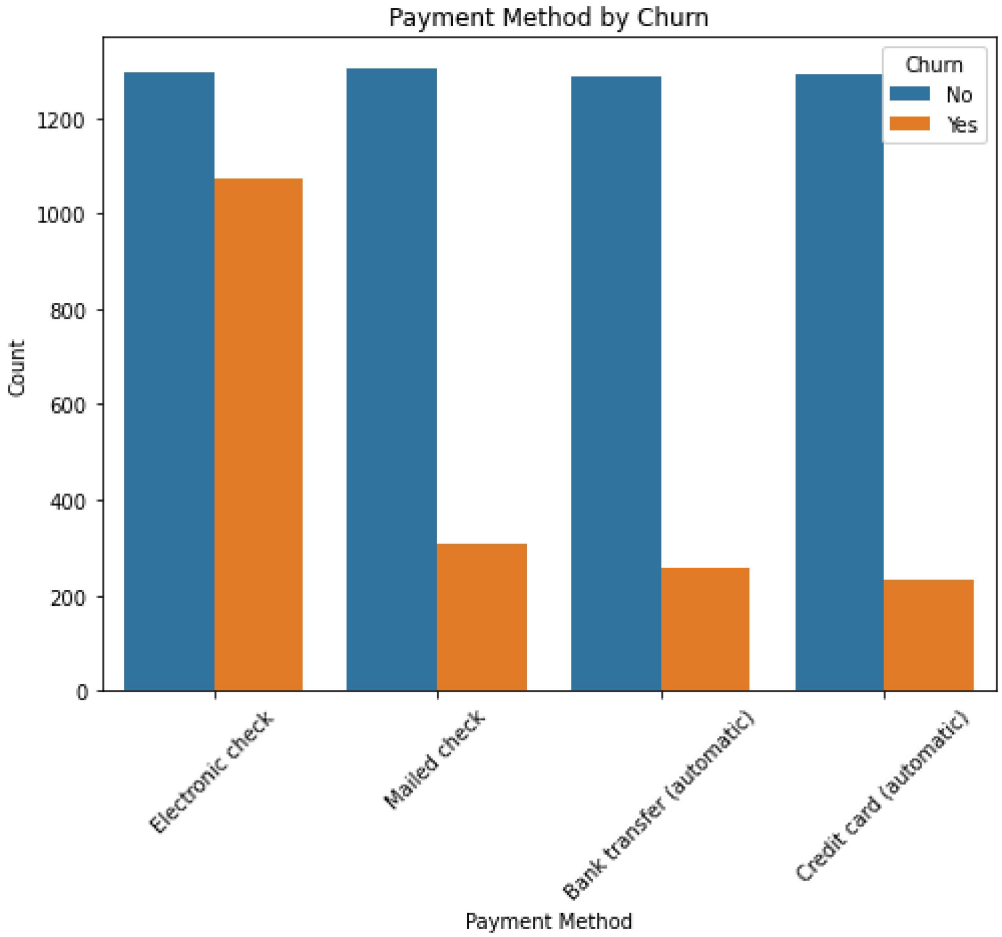
In [13]:
```
#examination the PhoneService in which the customers were enrolled for churn yes and churn no
color = {"Yes": 'blue', "No": 'green'}
fig = px.histogram(df, x="Churn",
                        color="PhoneService",
                        barmode="group",
                        color_discrete_map=color)
fig.update_layout(width=700, height=500, bargap=0.1)
fig.update_layout(title='Chrun distribuiton with Phone Service')

# Save the plot as an image file (when import as Jupyter notebook plot disappears)
fig.write_image("phone_service.png")

fig.show()
```



In [16]:
```python
# Payment method distribution
plt.figure(figsize=(8, 6))
sns.countplot(data=df, x='PaymentMethod')
plt.title('Payment Method Distribution')
plt.xlabel('Payment Method')
plt.ylabel('Count')
plt.xticks(rotation=45)
plt.show()

# Payment method and churn
plt.figure(figsize=(8, 6))
sns.countplot(data=df, x='PaymentMethod', hue='Churn')
```

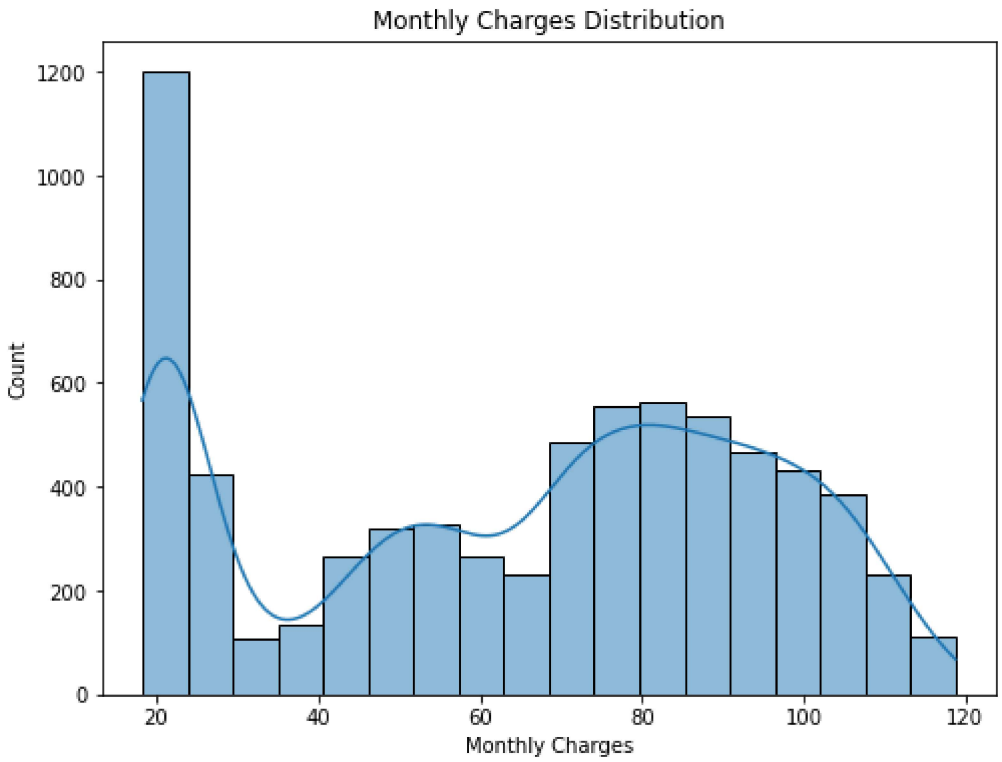
```
plt.title('Payment Method by Churn')
plt.xlabel('Payment Method')
plt.ylabel('Count')
plt.xticks(rotation=45)
plt.show()
```

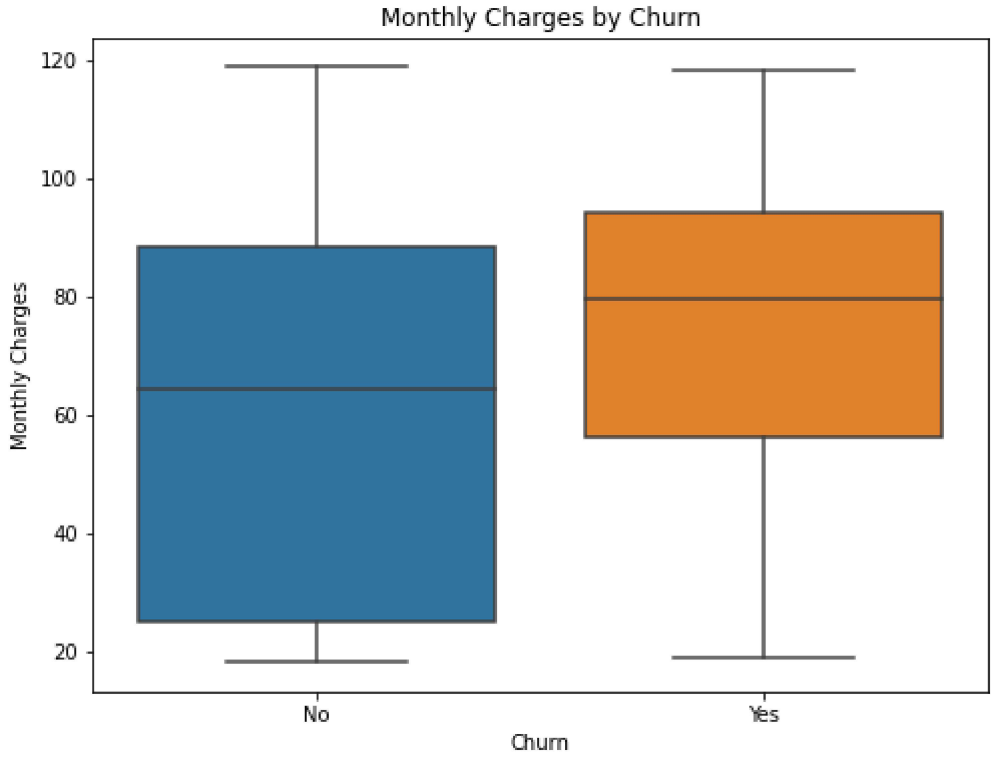




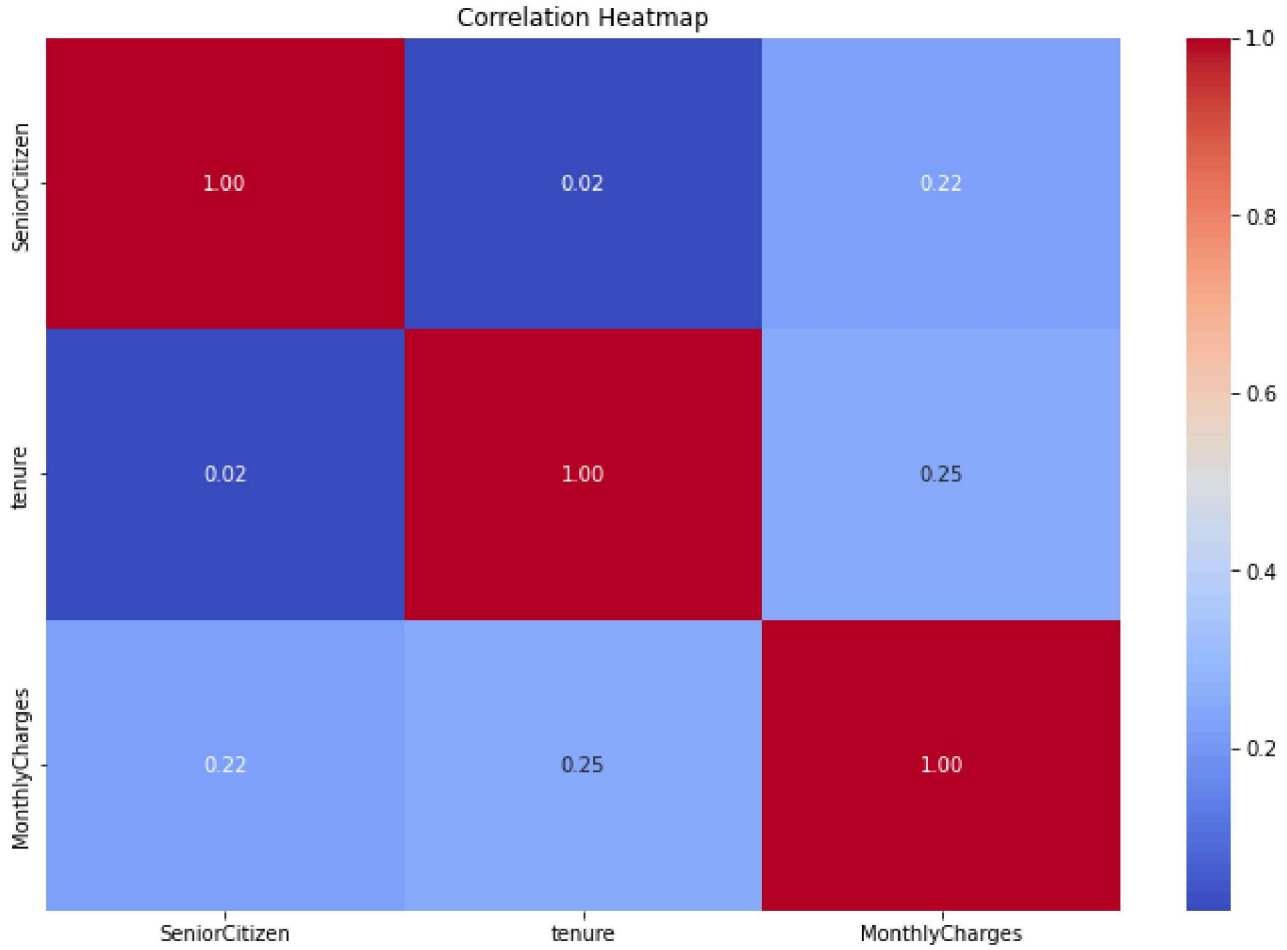
In [17]:
```
# Monthly charges distribution
plt.figure(figsize=(8, 6))
sns.histplot(data=df, x='MonthlyCharges', kde=True)
plt.title('Monthly Charges Distribution')
plt.xlabel('Monthly Charges')
plt.ylabel('Count')
plt.show()

# Average monthly charges for churned vs. non-churned customers
plt.figure(figsize=(8, 6))
sns.boxplot(data=df, x='Churn', y='MonthlyCharges')
plt.title('Monthly Charges by Churn')
plt.xlabel('Churn')
```

```
plt.ylabel('Monthly Charges')
plt.show()
```





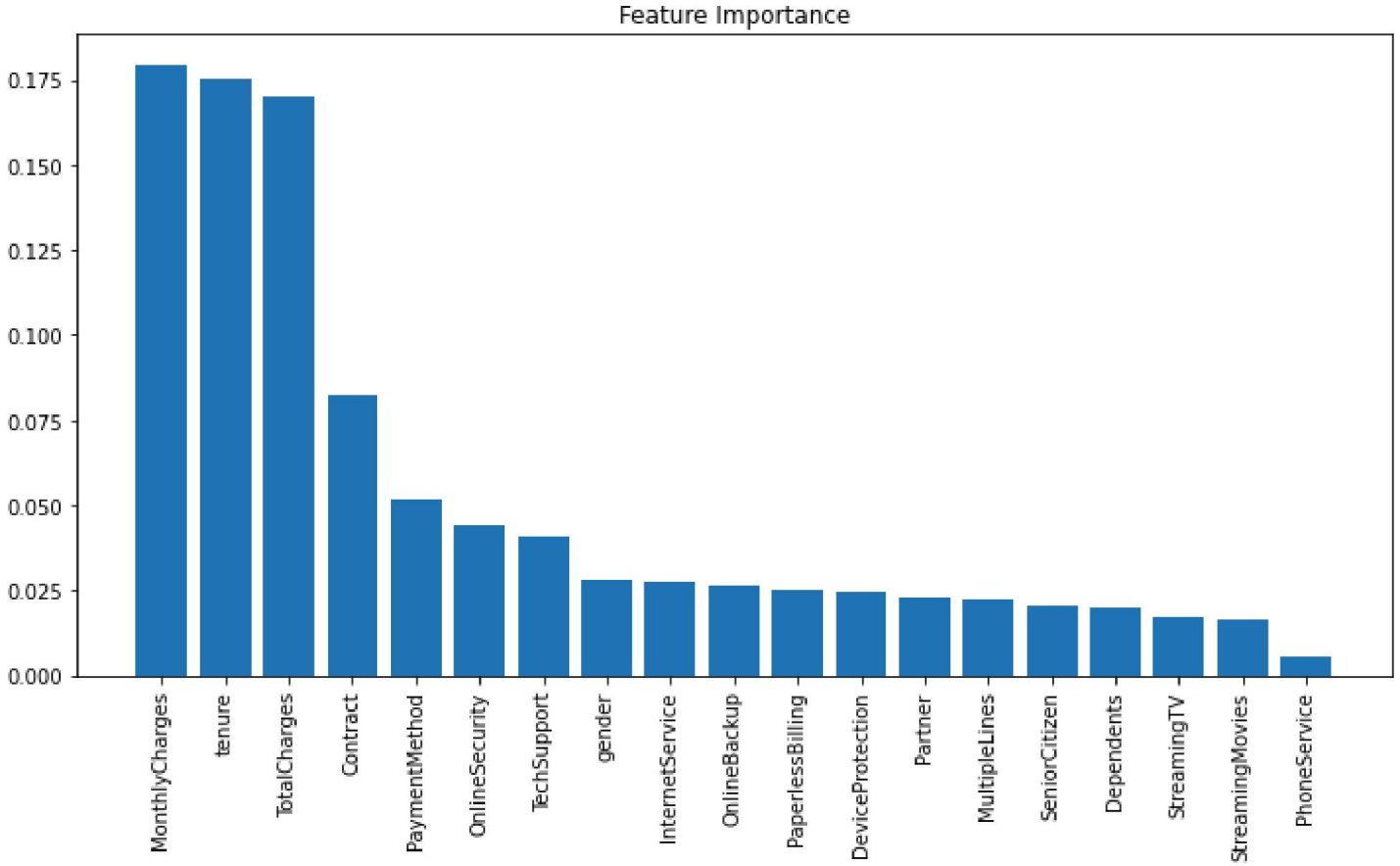
In [18]:
```
# Correlation heatmap
plt.figure(figsize=(12, 8))
sns.heatmap(df.corr(), annot=True, cmap='coolwarm', fmt='.2f')
plt.title('Correlation Heatmap')
plt.show()
```



In [22]:

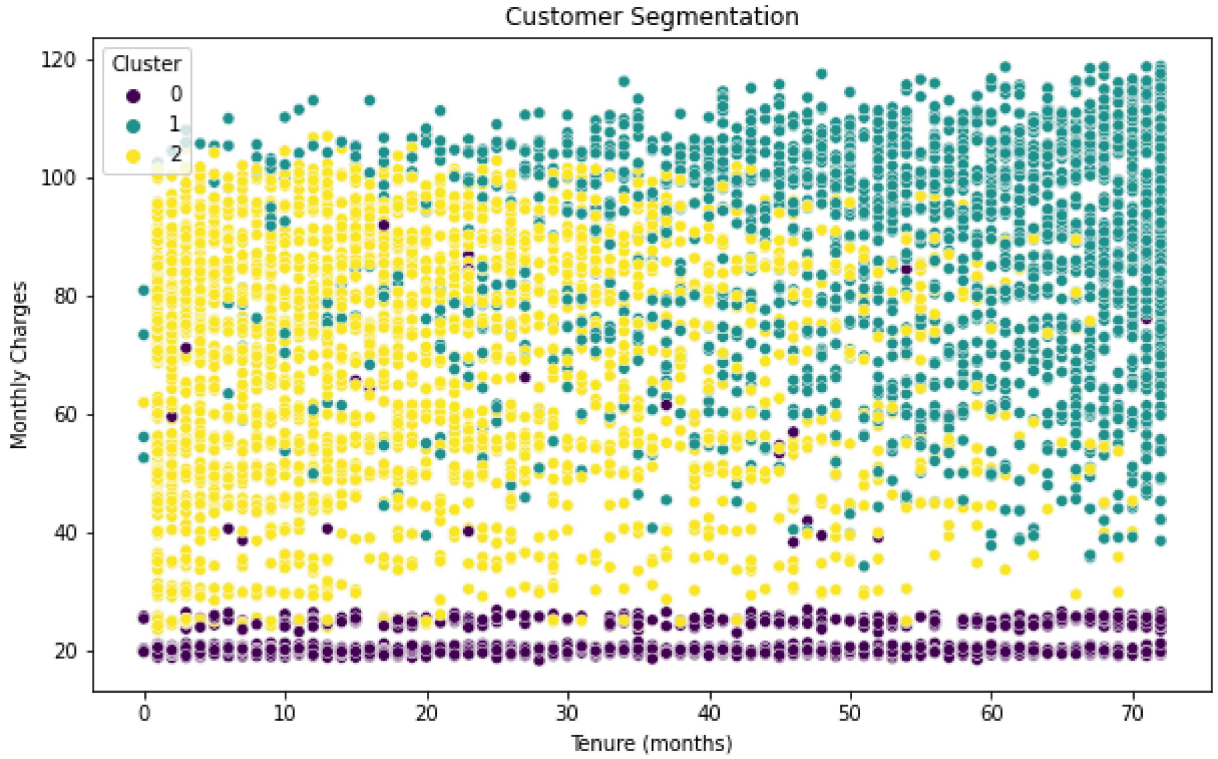
```
# Encode categorical variables
df_encoded = df.copy()
for column in df_encoded.select_dtypes(include=['object']).columns:
    df_encoded[column] = LabelEncoder().fit_transform(df_encoded[column])

# Train a Random Forest model
X = df_encoded.drop(columns=['Churn', 'customerID'])
y = df_encoded['Churn']
model = RandomForestClassifier()
model.fit(X, y)

# Feature importance
importances = model.feature_importances_
```

```
indices = np.argsort(importances)[::-1]
features = X.columns

plt.figure(figsize=(12, 6))
plt.title('Feature Importance')
plt.bar(range(X.shape[1]), importances[indices], align='center')
plt.xticks(range(X.shape[1]), features[indices], rotation=90)
plt.show()
```



In [27]:
```
# Standardize the data
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

# Apply K-Means clustering
kmeans = KMeans(n_clusters=3, random_state=42)
```

```
clusters = kmeans.fit_predict(X_scaled)

# Add cluster labels to the dataframe
df['Cluster'] = clusters

# Visualize the clusters
plt.figure(figsize=(10, 6))
sns.scatterplot(data=df, x='tenure', y='MonthlyCharges', hue='Cluster', palette='viridis', legend='full')
plt.title('Customer Segmentation')
plt.xlabel('Tenure (months)')
plt.ylabel('Monthly Charges')
plt.legend(title='Cluster')
plt.show()
```



In [125…

```
#source of data:
#https://www.kaggle.com/code/bhartiprasad17/customer-churn-prediction/data
```