In [64]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from scipy import stats
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix
```

In [26]:

```
df_size = 1000
np.random.seed(42)
serv_length = np.random.randint(1, 50, df_size)
monthly_charges = np.random.uniform(20, 100, size=1000)
churn_prob = [0.4, 0.6]
churn = np.random.choice(['Yes', 'No'], size=df_size, p=churn_prob)
churn_data = {
    'CustomerID': list(range(1001, 2001)),
    'Gender': np.random.choice(['Male', 'Female'], size=df_size),
    'Age': np.random.randint(18, 70, df_size),
    'ServiceLength (months)': serv_length,
    'ContractType': np.random.choice(['Two-Year', 'One-Year', 'Month-to-Month'], size=df
    'MonthlyCharges (USD)': monthly_charges,
    'TotalCharges (USD)': serv_length * monthly_charges * 0.9,'Churn': churn
}
```

In [16]:

```
df = pd.DataFrame(churn_data)
```

In [18]:

```
df.head()
```

Out[18]:

	CustomerID	Gender	Age	ServiceLength (months)	ContractType	MonthlyCharges (USD)	TotalCharges (USD)	C
0	1001	Male	66	39	Two-Year	75.756917	2659.067786	
1	1002	Female	27	29	Month-to-Month	99.780443	2604.269557	
2	1003	Male	45	15	Two-Year	91.728821	1238.339084	
3	1004	Male	38	43	Two-Year	66.079873	2557.291102	
4	1005	Male	67	8	Two-Year	93.391649	672.419873	

In [19]:

```
df.describe()
```

Out[19]:

	CustomerID	Age	ServiceLength (months)	MonthlyCharges (USD)	TotalCharges (USD)
count	1000.000000	1000.000000	1000.000000	1000.000000	1000.000000
mean	1500.500000	43.947000	25.379000	60.812403	1374.978457
std	288.819436	14.853984	14.122138	22.597415	960.461013
min	1001.000000	18.000000	1.000000	20.019002	18.074123
25%	1250.750000	32.000000	13.000000	41.524641	564.412028
50%	1500.500000	44.000000	26.000000	62.128091	1205.314557
75%	1750.250000	57.000000	37.000000	79.855529	1944.868429
max	2000.000000	69.000000	49.000000	99.948280	4295.379738

In [20]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 8 columns):
 #   Column                  Non-Null Count  Dtype  
---  ------                  --------------  -----  
 0   CustomerID              1000 non-null   int64  
 1   Gender                  1000 non-null   object 
 2   Age                     1000 non-null   int32  
 3   ServiceLength (months)  1000 non-null   int32  
 4   ContractType            1000 non-null   object 
 5   MonthlyCharges (USD)    1000 non-null   float64
 6   TotalCharges (USD)      1000 non-null   float64
 7   Churn                   1000 non-null   object 
dtypes: float64(2), int32(2), int64(1), object(3)
memory usage: 54.8+ KB
```

In [21]:

```
df.isnull().sum()
```

Out[21]:

```
CustomerID              0
Gender                  0
Age                     0
ServiceLength (months)  0
ContractType            0
MonthlyCharges (USD)    0
TotalCharges (USD)      0
Churn                   0
dtype: int64
```

In [22]:

```
df.duplicated().head()
```

Out[22]:

```
0    False
1    False
2    False
3    False
4    False
dtype: bool
```

In [24]:

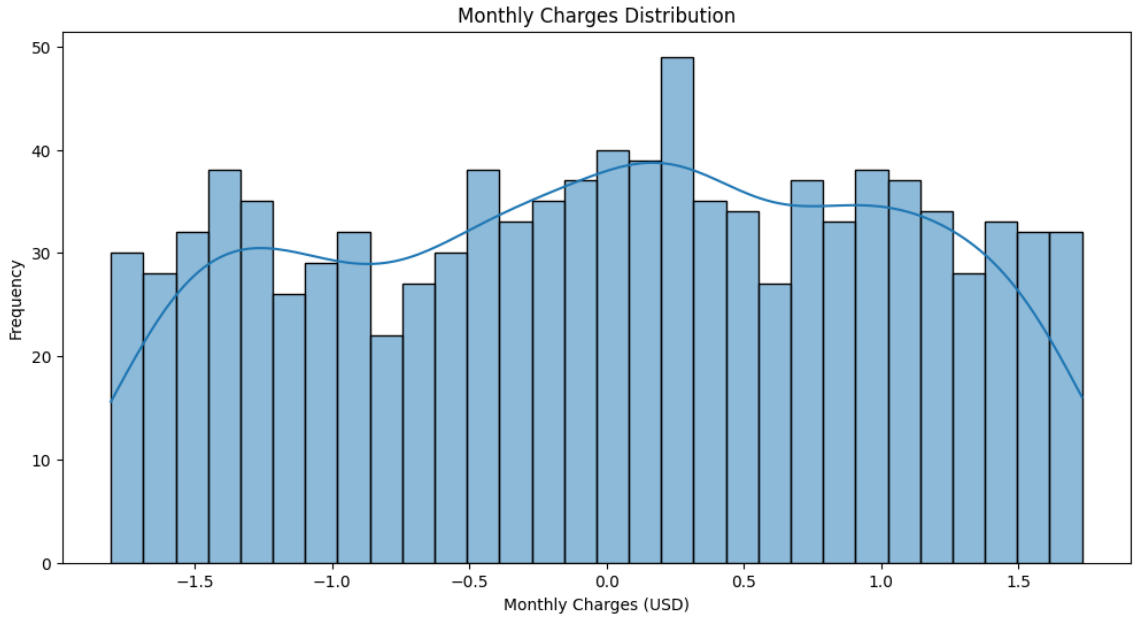
```
label_encoder = LabelEncoder()
df['Gender'] = label_encoder.fit_transform(df['Gender'])
df['ContractType'] = label_encoder.fit_transform(df['ContractType'])
df['Churn'] = label_encoder.fit_transform(df['Churn'])
```

In [25]:

```
scaler = StandardScaler()
num_cols = ['Age', 'ServiceLength (months)', 'MonthlyCharges (USD)', 'TotalCharges (USD)
df[num_cols] = scaler.fit_transform(df[num_cols])
```

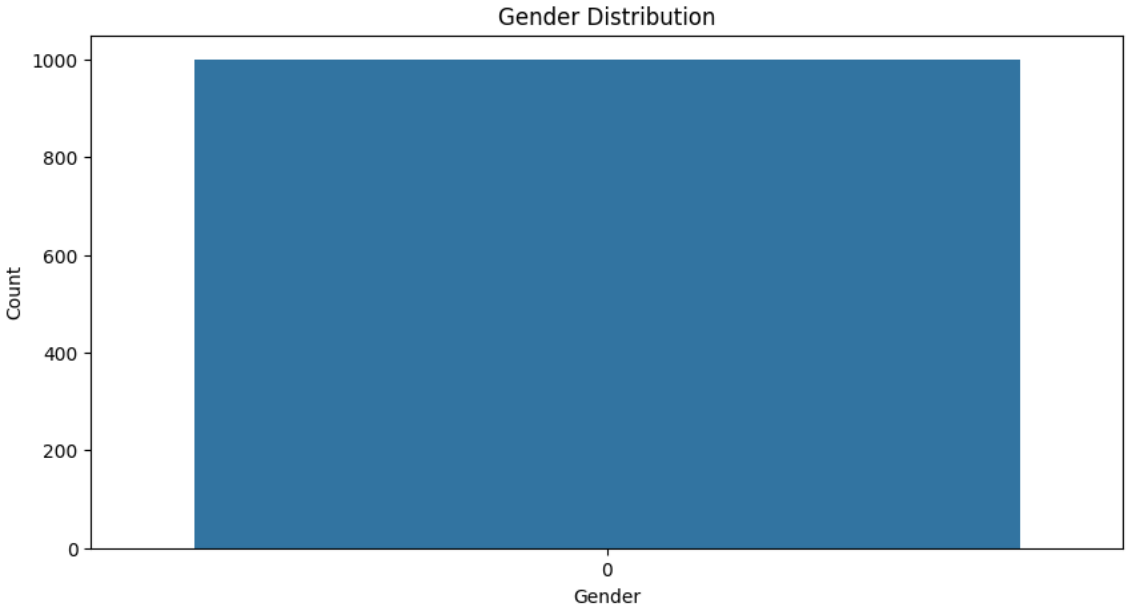
In [29]:

```
plt.figure(figsize=(12, 6))
sns.histplot(df['MonthlyCharges (USD)'], bins=30, kde=True)
plt.title('Monthly Charges Distribution')
plt.xlabel('Monthly Charges (USD)')
plt.ylabel('Frequency')
plt.show()
```



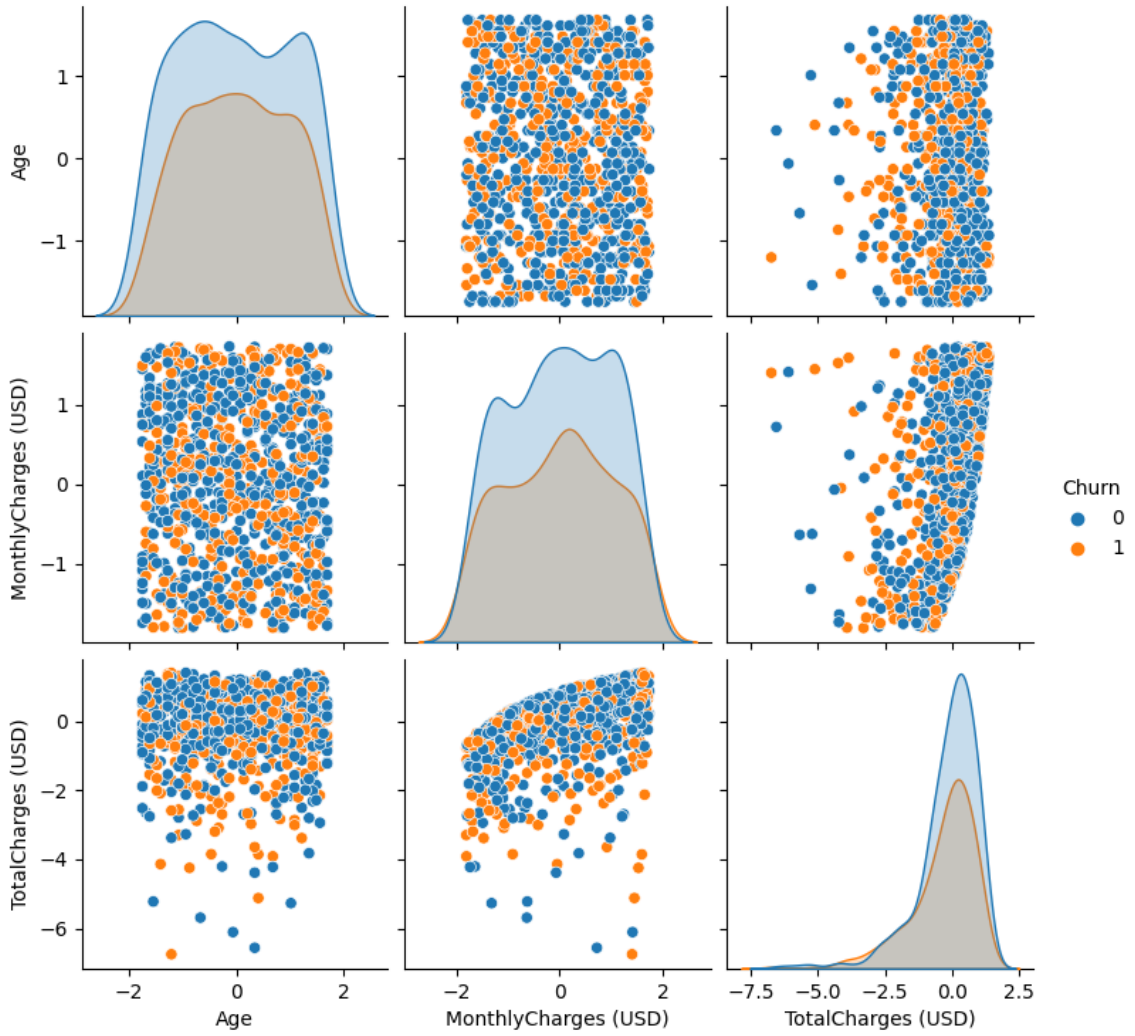
In [30]:

```
plt.figure(figsize=(10, 5))
sns.countplot(df['Gender'])
plt.title('Gender Distribution')
plt.xlabel('Gender')
plt.ylabel('Count')
plt.show()
```



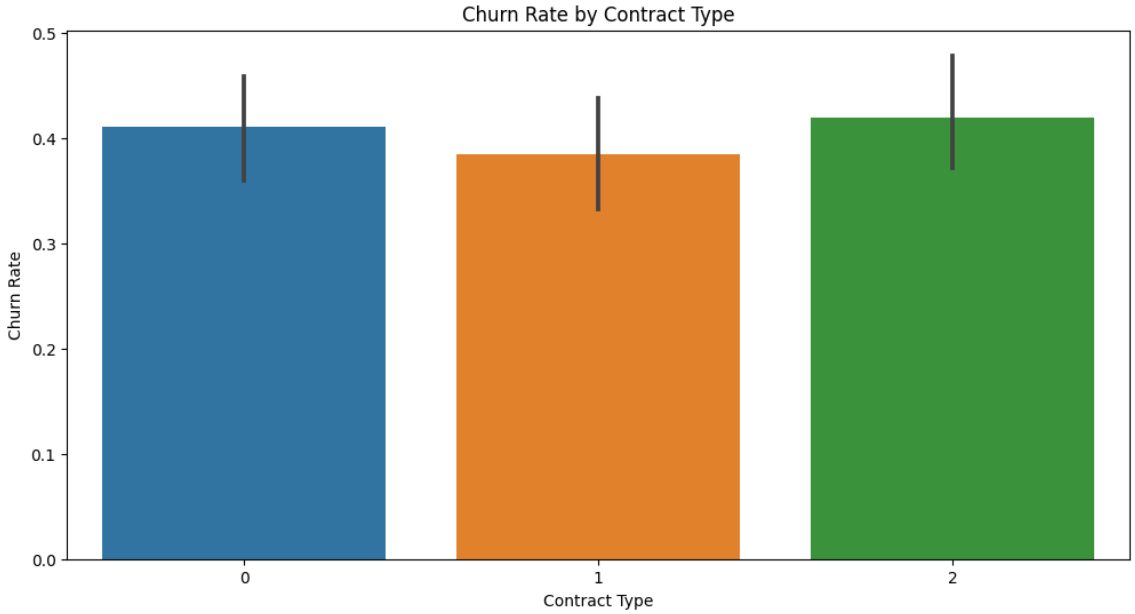
In [31]:

```
sns.pairplot(df[['Age', 'MonthlyCharges (USD)', 'TotalCharges (USD)', 'Churn']], hue='Ch
plt.show()
```



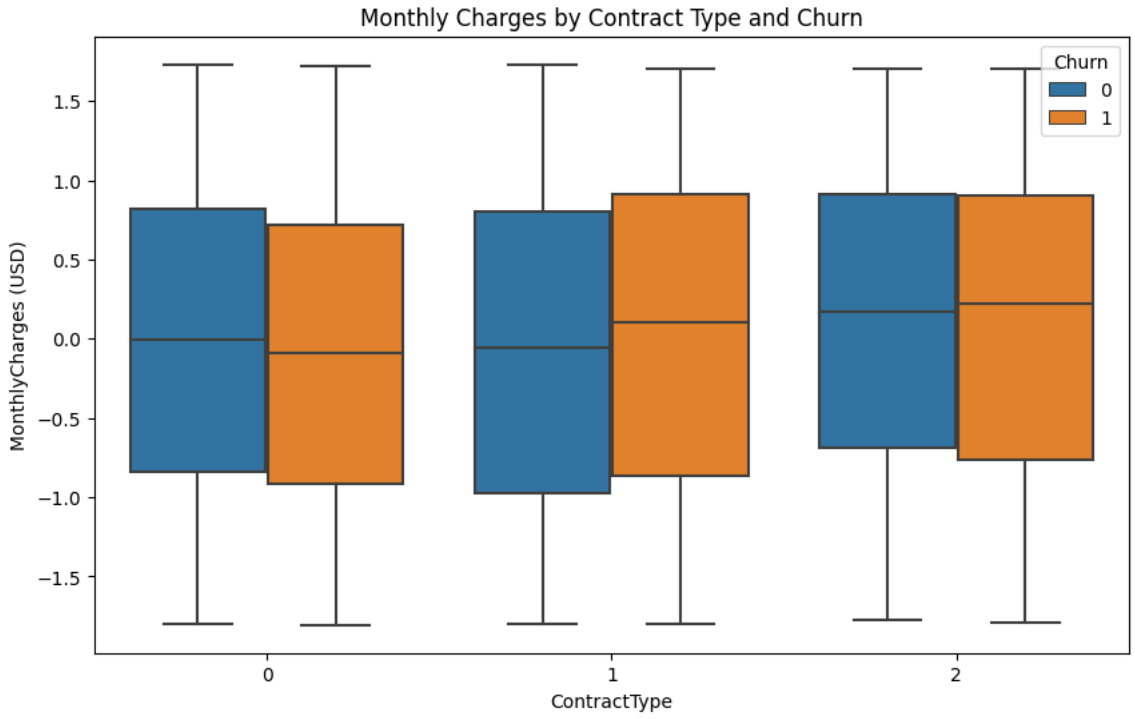
In [32]:

```
plt.figure(figsize=(12, 6))
sns.barplot(x='ContractType', y='Churn', data=df)
plt.title('Churn Rate by Contract Type')
plt.xlabel('Contract Type')
plt.ylabel('Churn Rate')
plt.show()
```



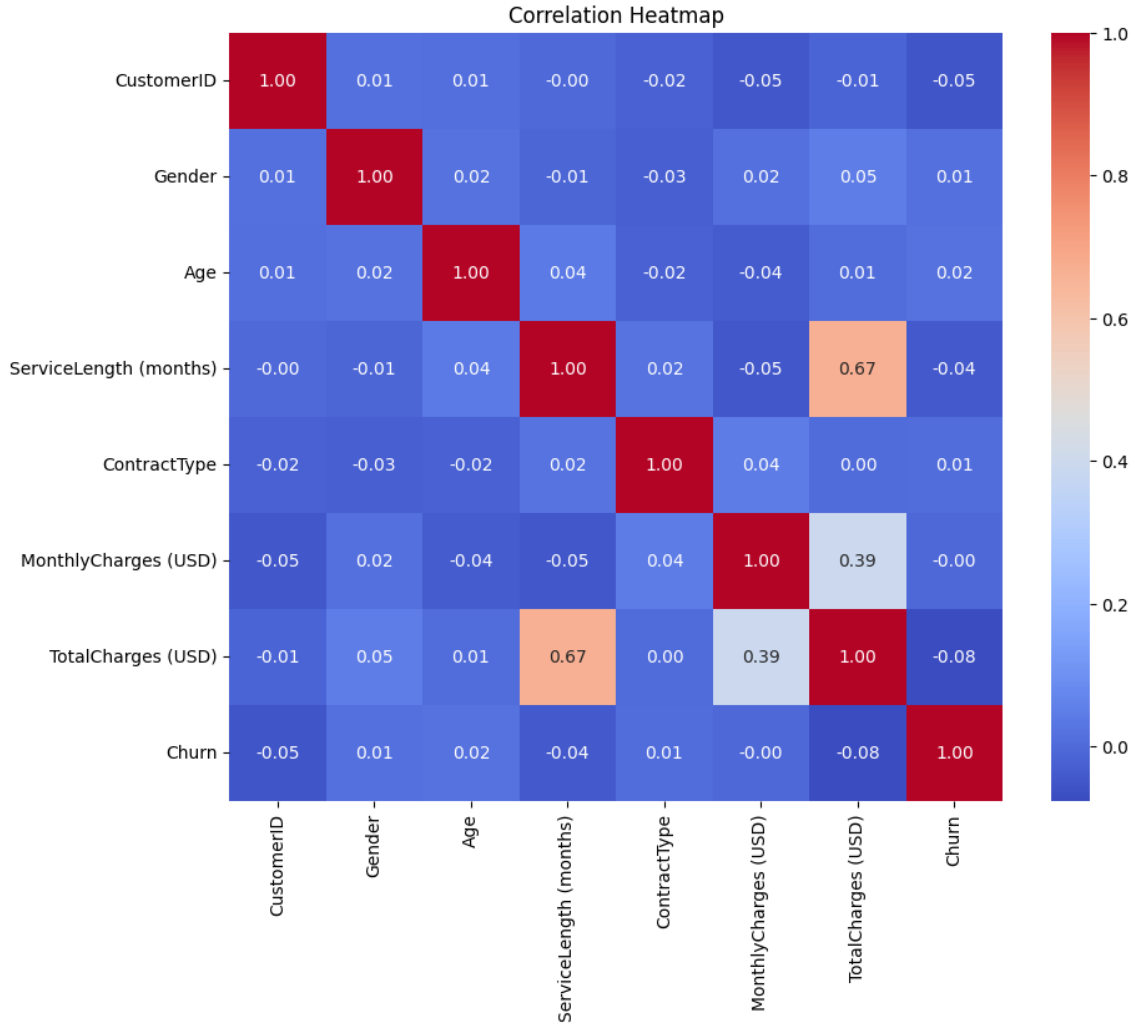
In [33]:

```
plt.figure(figsize=(10, 6))
sns.boxplot(data=df, x='ContractType', y='MonthlyCharges (USD)', hue='Churn')
plt.title('Monthly Charges by Contract Type and Churn')
plt.show()
```



In [35]:

```
plt.figure(figsize=(10, 8))
correlation_matrix = df.corr()
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Correlation Heatmap')
plt.show()
```



In [37]:

```
X = df.drop('Churn', axis=1)
y = df['Churn']
```

In [38]:

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42
```

In [39]:

```
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)
```

In [49]:

```
logistic_model = LogisticRegression(random_state=42)
logistic_model.fit(X_train_scaled, y_train)
```

Out[49]:

```
LogisticRegression
LogisticRegression(random_state=42)
```

In [43]:

```
missing_values = np.isnan(X_train_scaled).sum()
missing_values
```

Out[43]:

```
134
```

In [44]:

```
from sklearn.impute import SimpleImputer
imputer = SimpleImputer(strategy='mean')
X_train_scaled = imputer.fit_transform(X_train_scaled)
```

In [48]:

```
X_train_scaled[np.isnan(X_train_scaled)] = 0
y_train = y_train[~np.isnan(X_train_scaled).any(axis=1)]
```

In [57]:

```
logistic_predictions = logistic_model.predict(X_test_scaled)
```

In [52]:

```
missing_values = np.isnan(X_test_scaled).sum()
missing_values
```

Out[52]:

```
36
```

In [54]:

```
from sklearn.impute import SimpleImputer

imputer = SimpleImputer(strategy='mean')
X_test_scaled = imputer.fit_transform(X_test_scaled)
```

In [55]:

```
X_test_scaled[np.isnan(X_test_scaled)] = 0
```

In [56]:

```
y_test = y_test[~np.isnan(X_test_scaled).any(axis=1)]
```

In [58]:

```
print("Logistic Regression Model:")
print("Accuracy:", accuracy_score(y_test, logistic_predictions))
print("Classification Report:\n", classification_report(y_test, logistic_predictions))
print("Confusion Matrix:\n", confusion_matrix(y_test, logistic_predictions))
```

```
Logistic Regression Model:
Accuracy: 0.615
Classification Report:
              precision    recall  f1-score   support

           0       0.62      0.98      0.76       123
           1       0.50      0.03      0.05        77

    accuracy                           0.61       200
   macro avg       0.56      0.50      0.40       200
weighted avg       0.57      0.61      0.49       200

Confusion Matrix:
 [[121   2]
 [ 75   2]]
```

In [ ]:

In [ ]:

In [ ]:

In [ ]: