```
import pandas as pd
import numpy as np
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.metrics import mean_squared_error, r2_score
```

```
df = pd.read_csv('Advertising.csv')
```

```
print(df.head(5))
```

```
   Unnamed: 0     TV  Radio  Newspaper  Sales
0           1  230.1   37.8       69.2   22.1
1           2   44.5   39.3       45.1   10.4
2           3   17.2   45.9       69.3    9.3
3           4  151.5   41.3       58.5   18.5
4           5  180.8   10.8       58.4   12.9
```

```
print(df.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 5 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   Unnamed: 0  200 non-null    int64  
 1   TV          200 non-null    float64
 2   Radio       200 non-null    float64
 3   Newspaper   200 non-null    float64
 4   Sales       200 non-null    float64
dtypes: float64(4), int64(1)
memory usage: 7.9 KB
None
```

```
print(df.describe())
```

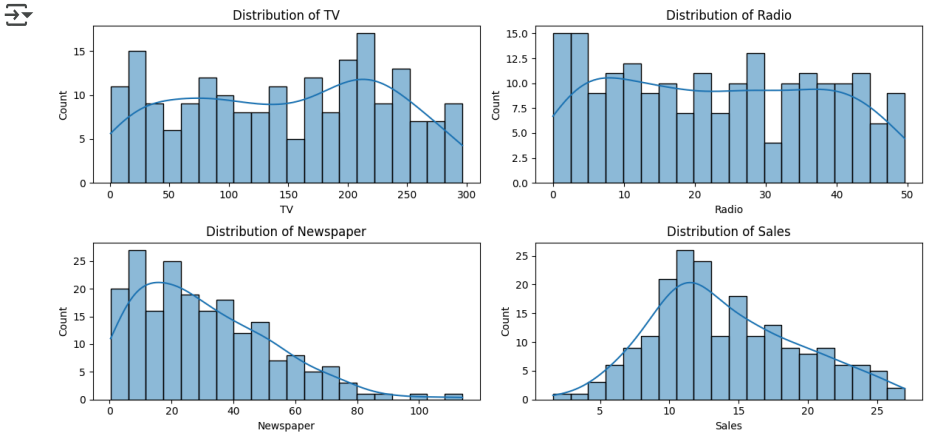
```
       Unnamed: 0          TV       Radio   Newspaper       Sales
count  200.000000  200.000000  200.000000  200.000000  200.000000
mean   100.500000  147.042500   23.264000   30.554000   14.022500
std     57.879185   85.854236   14.846809   21.778621    5.217457
min      1.000000    0.700000    0.000000    0.300000    1.600000
25%     50.750000   74.375000    9.975000   12.750000   10.375000
50%    100.500000  149.750000   22.900000   25.750000   12.900000
75%    150.250000  218.825000   36.525000   45.100000   17.400000
max    200.000000  296.400000   49.600000  114.000000   27.000000
```

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

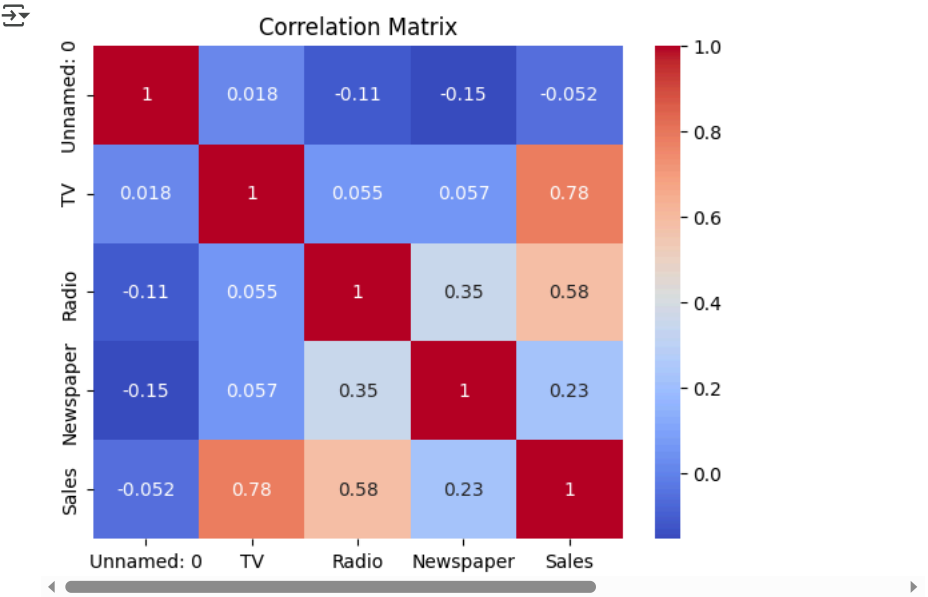
```
Unnamed: 0    0
TV            0
Radio         0
```

```
Newspaper     0
Sales         0
dtype: int64
```

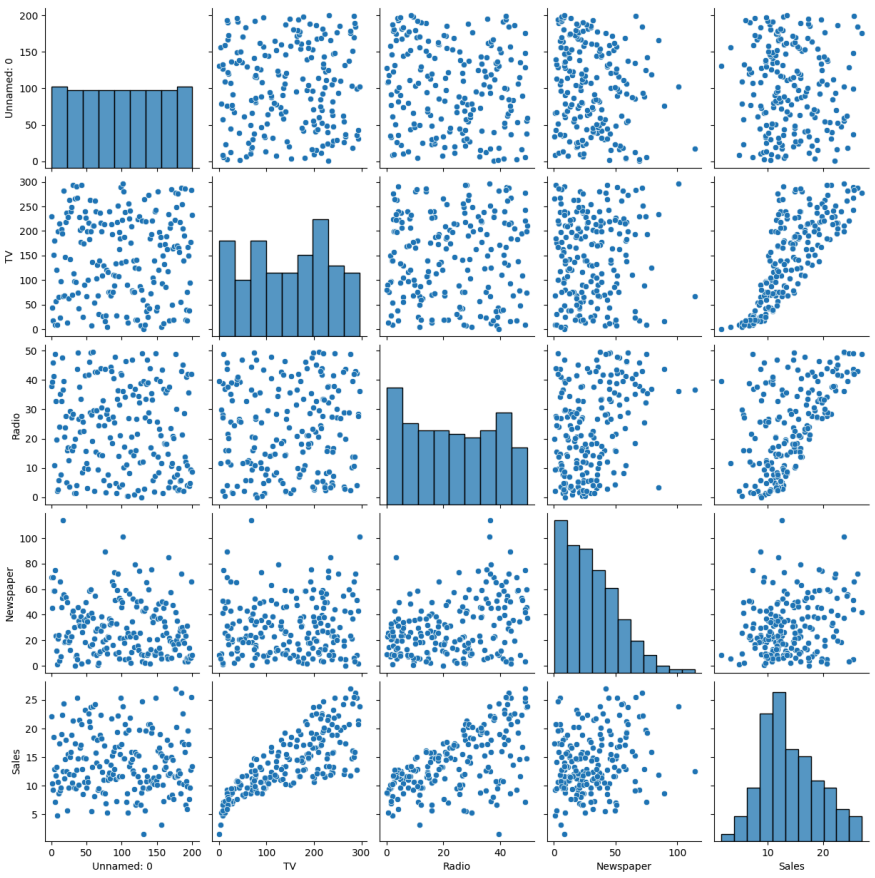
```
# Visualize the distribution of features
plt.figure(figsize=(12, 6))
for i, column in enumerate(['TV', 'Radio', 'Newspaper', 'Sales'], 1):
    plt.subplot(2, 2, i)
    sns.histplot(df[column], kde=True, bins=20)
    plt.title(f'Distribution of {column}')
plt.tight_layout()
plt.show()
```




```
# Correlation matrix
correlation_matrix = df.corr()
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm')
plt.title('Correlation Matrix')
plt.show()
```




```
# Pairplot to visualize relationships between variables
sns.pairplot(df)
plt.show()
```




```
df.drop(columns=['Unnamed: 0'], inplace=True, errors='ignore')
```

```
# Define features (X) and target variable (y)
X = df[['TV', 'Radio', 'Newspaper']]
y = df['Sales']
```

```
# Split the data into training and testing sets (80% train, 20% test)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=
```

```
# Check the shapes of the datasets
print("Training set shape:", X_train.shape, y_train.shape)
print("Testing set shape:", X_test.shape, y_test.shape)
```

```
Training set shape: (160, 3) (160,)
Testing set shape: (40, 3) (40,)
```

```
model = LinearRegression()
```

```
# Train the model on the training data
model.fit(X_train, y_train)
```

```
▸ LinearRegression
```

```
# Print the coefficients and intercept
print("Coefficients:", model.coef_)
print("Intercept:", model.intercept_)
```

```
Coefficients: [0.04472952 0.18919505 0.00276111]
Intercept: 2.979067338122629
```

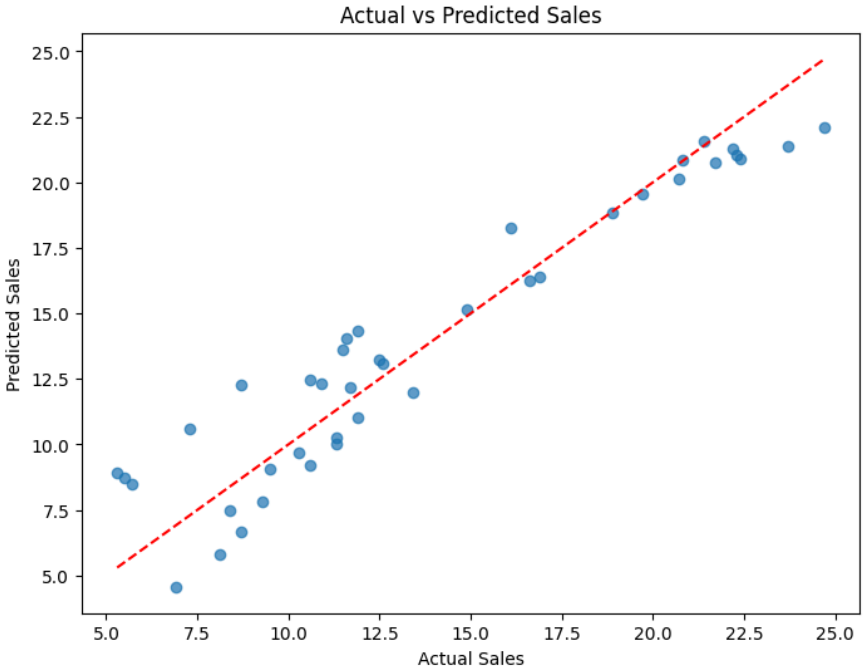
```
y_pred = model.predict(X_test)
```

```
# Calculate evaluation metrics
mse = mean_squared_error(y_test, y_pred)
rmse = np.sqrt(mse)
r2 = r2_score(y_test, y_pred)
```

```
# Print the evaluation metrics
print("Mean Squared Error (MSE):", mse)
print("Root Mean Squared Error (RMSE):", rmse)
print("R-squared (R2):", r2)
```

```
Mean Squared Error (MSE): 3.1740973539761033
Root Mean Squared Error (RMSE): 1.78159966153345
R-squared (R2): 0.899438024100912
```

```
# Visualize actual vs predicted values
plt.figure(figsize=(8, 6))
plt.scatter(y_test, y_pred, alpha=0.7)
plt.plot([y_test.min(), y_test.max()], [y_test.min(), y_test.max()], color='red', lines
plt.xlabel('Actual Sales')
plt.ylabel('Predicted Sales')
plt.title('Actual vs Predicted Sales')
plt.show()
```




```
# Create a DataFrame to display feature importance
feature_importance = pd.DataFrame({
    'Feature': X.columns,
    'Coefficient': model.coef_
}).sort_values(by='Coefficient', ascending=False)

print(feature_importance)
```

```
       Feature  Coefficient
    1      Radio     0.189195
    0         TV     0.044730
    2  Newspaper     0.002761
```

```
import joblib
```