In [39]:

```
import numpy as np
import pandas as pd
import math as mth
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, accuracy_score, mean_absolute_error
```

In [2]:

```
#made by yours truly, Mohamed Ehab
```

In [3]:

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

In [4]:

```
df.head()
```

Out[4]:

	TV	Radio	Newspaper	Sales
0	230.1	37.8	69.2	22.1
1	44.5	39.3	45.1	10.4
2	17.2	45.9	69.3	12.0
3	151.5	41.3	58.5	16.5
4	180.8	10.8	58.4	17.9

In [5]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 4 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   TV         196 non-null    float64
 1   Radio      195 non-null    float64
 2   Newspaper  195 non-null    float64
 3   Sales      200 non-null    float64
dtypes: float64(4)
memory usage: 6.4 KB
```

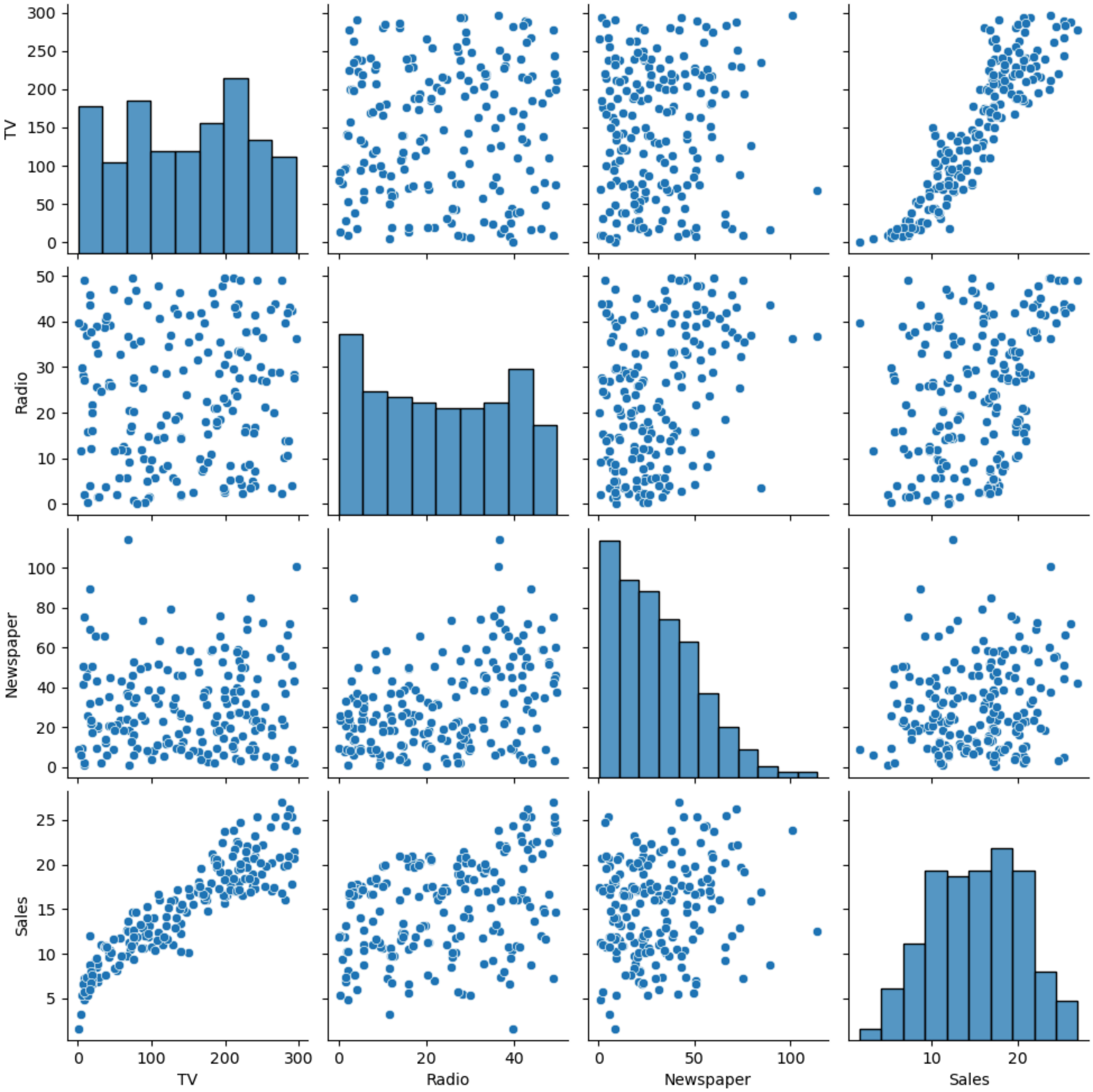
In [38]:

```
sns.pairplot(df)
```

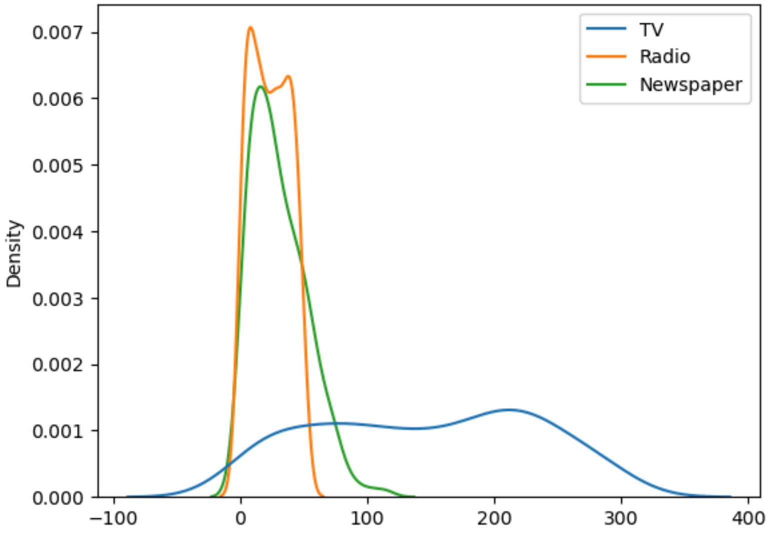
```
C:\ProgramData\anaconda3\Lib\site-packages\seaborn\axisgrid.py:118: UserWarning: The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```

Out[38]:

```
<seaborn.axisgrid.PairGrid at 0x22a051e66d0>
```



```
In [37]: sns.kdeplot(df[['TV','Radio','Newspaper']])

Out[37]: <Axes: ylabel='Density'>
```



```
In [8]: print(f'How many duplicated values?: {df.duplicated().sum()}')
        print(f"Null or missing values:\n{df.isnull().sum()}")

        How many duplicated values?: 0
        Null or missing values:
        TV           4
        Radio        5
        Newspaper    5
        Sales        0
        dtype: int64
```

```
In [9]: df_clean = df.fillna(method='ffill')
```

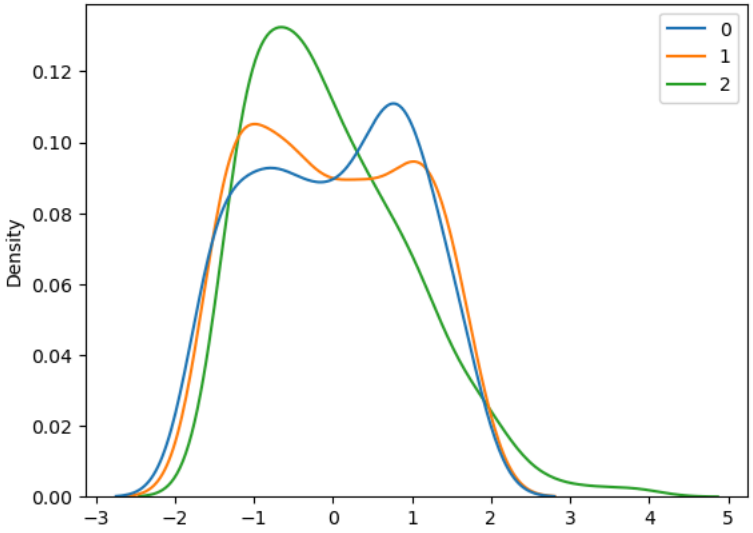
```
In [10]: print(f'How many duplicated values after cleaning?: {df_clean.duplicated().sum()}')
         print(f"Null or missing values after cleaning:\n{df_clean.isnull().sum()}")

         How many duplicated values after cleaning?: 0
         Null or missing values after cleaning:
         TV           0
         Radio        0
         Newspaper    0
         Sales        0
         dtype: int64
```

```
In [11]: X = df_clean[[col for col in df.columns if col != "Sales"]]
         y = df_clean[["Sales"]]
```

```
In [12]: scaler = StandardScaler()
         X_scaled = scaler.fit_transform(X)
```

```
In [13]: sns.kdeplot(X_scaled)
```

```
Out[13]: <Axes: ylabel='Density'>
```



```
In [14]: X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.3)
         model = LinearRegression()
```

```
In [15]: model.fit(X_train,y_train)
```

```
Out[15]: ▾ LinearRegression
         LinearRegression()
```

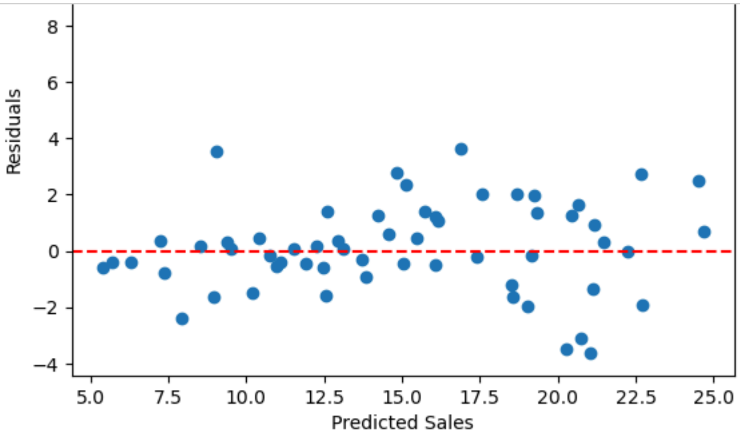
```
In [16]: y_pred = model.predict(X_test)
```

```
In [17]: y_pred_int = y_pred.astype(int)
         y_test_int = y_test.astype(int)
```

```
In [40]: mse = round(mean_squared_error(y_test, y_pred),3)
         rmse = round(mth.sqrt(mse),2)
         accuracy =accuracy_score(y_pred_int, y_test_int)
         mae = round(mean_absolute_error(y_test,y_pred),3)
         print(f"Mean squared error: {mse}\nRoot mean squared error: {rmse}\nAccuracy score: {round(accuracy,3)}\nMean absolute error: {ma
```

```
Mean squared error: 4.988
Root mean squared error: 2.23
Accuracy score: 0.3
Mean absolute error: 1.396
```

```
In [21]: residuals = y_test - y_pred

         plt.scatter(y_pred, residuals)
         plt.axhline(y=0, color='red', linestyle='--')
         plt.xlabel('Predicted Sales')
         plt.ylabel('Residuals')
         plt.title('Residuals Plot')
         plt.show()
```



although our errors are high, the scaled data we entered is a good fit for our regression model as we can conclude from **Residual plot**: the residuals are randomly scattered showing a linearity between the three features we entered.

our model can be far enhanced by **removing outliers** and **entering more data** for more accurate predictions